Draft

Santa Rosa Subregional Long-Term Wastewater Project

Environmental Impact Report
Environmental Impact Statement

July 1996

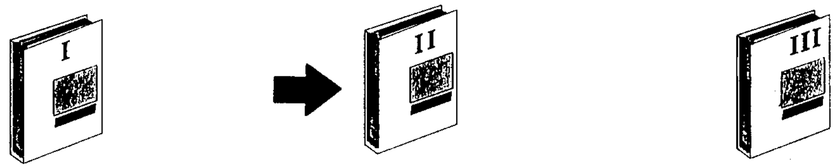
Volume II
Chapter 4.1-4.10

DOCUMENT STRUCTURE

You are in Volume II

The Santa Rosa Subregional Long-Term Wastewater Project Draft Environmental Impact Report/Environmental Impact Statement (EIR/EIS) is presented in seventeen volumes. Volumes I, II, and III contain the main body of the Draft EIR/EIS.

DRAFT EIR/EIS



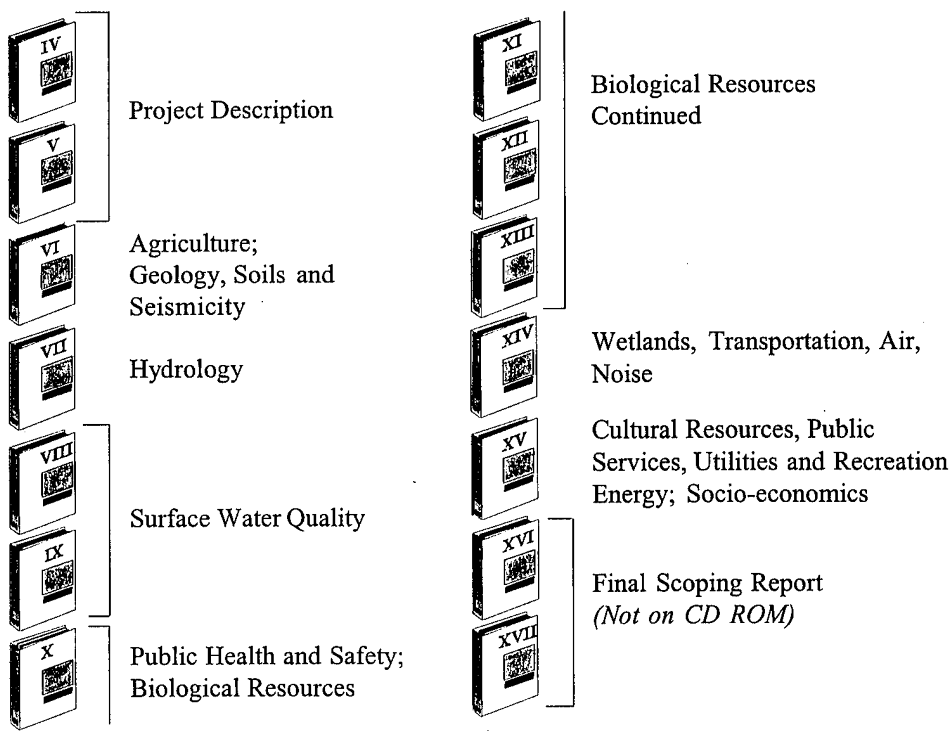
Summary and Introduction, Mitigation Program, Project Description

Impact Analysis Sections

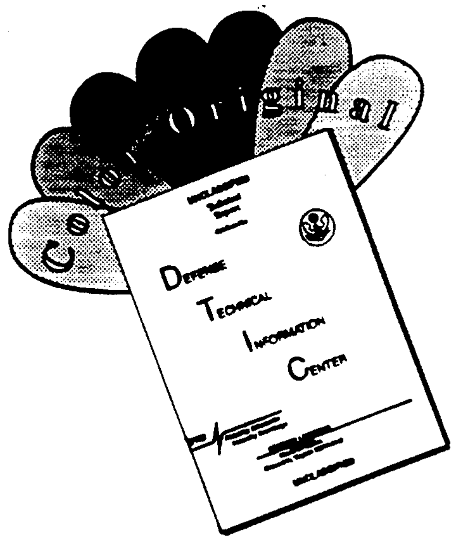
Impact Analysis Sections Continued

APPENDICES TO THE EIR/EIS

Volumes IV through XVII contain the appendices to the EIR/EIS. The graphic below displays the organization of the volumes and topic areas contained in each.



DISCLAIMER NOTICE



THIS DOCUMENT IS BEST QUALITY AVAILABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF COLOR PAGES WHICH DO NOT REPRODUCE LEGIBLY ON BLACK AND WHITE MICROFICHE.

READING THE EIR/EIS

The document is organized to allow review at three levels of detail, depending on the reader's interest. Chapter 1 (Volume I), Introduction and Summary, provides an overview of impacts. Volumes I, II, and III combined contain the complete EIR/EIS; Volumes IV through XVII contain the technical appendices which support the Draft EIR/EIS. The summary in Volume I is not intended to replace the complete EIR/EIS which provides a thorough evaluation of the environmental impacts.

Volume I includes the Intoduction and Summary, Mitigation Program, and Project Description providing the reader with an overview of the major findings of the Draft EIR/EIS.

Volumes II and III include the environmental evaluation of the Project components and alternatives. The volumes also contain a discussion of the environmentally superior alternative, growth-inducing impacts, the significant and unavoidable impacts, and a glossary of terms.

Volumes IV through XVII contain the appendices to the EIR/EIS. The Appendices are available for use as supporting documentation for the EIR/EIS providing more extensive data on the settings and analysis.

USING THE TABLE OF CONTENTS

To assist the reader in locating information within the documents, a Table of Contents is in each volume. Tabs are used to assist the reader in locating chapters. Each chapter or appendix contains a more detailed Table of Contents to further direct the reader to the location of information. Due to the amount of information in Chapter 4 (Volumes II and III), Affected Environment and Environmental Consequences, a table of contents is provided for each of the 19 sections in this chapter.

USING THE CD ROM

In the CD ROM version of the Draft EIR/EIS, the underlined references are Hyperlinked text, which, when double clicked, will take the reader to the appropriate section in the appendix document.

HOW TO COMMENT ON THE DRAFT EIR/EIS

A discussion on how to comment on the Draft EIR/EIS is provided in Chapter 1 (Volume 1), Introduction and Summary.

ADDITIONAL ASSISTANCE

An introduction is provided at the beginning of each chapter or section of the Draft EIR/EIS contained in Volumes I, II, and III. The introduction provides information about the contents of the chapter or section.

TABLE OF CONTENTS

VOLUME IV APPENDICES D-1 THROUGH D-23

DESCRIPTION OF EXISTING SYSTEM AND ALTERNATIVES (PROJECT DESCRIPTION)

VOLUME V APPENDICES D-24 THROUGH D-32

DESCRIPTION OF EXISTING SYSTEM AND ALTERNATIVES (PROJECT DESCRIPTION), CONTINUED

VOLUME VI APPENDICES E AND F

LAND USE

No supporting documents produced.

AGRICULTURE

E-1 Irrigation Suitability Land Classification - South County Area
E-2 Irrigation Suitability Land Classification - West County Area
E-3 Cropping Scenarios for the West County and South County Reclamation Alternatives
E-4 Agricultural Impact Analysis Methodology
E-5 Irrigation Water Quality and Salt Management Leaching Requirements, South County and West County Reclamation Alternatives
E-6 Trace Element Loading Analysis for the South and West County Alternatives
E-7 Evaluation of Soil Erosion Impacts for the West and South County Reclamation Alternatives

GEOLOGY, SOILS, AND SEISMICITY

F-1 Geotechnical Assessment of Alternative Reservoir Sites and Pipeline Routes Volume I
F-2 Induced Seismicity Study-Geysers Recharge Alternative

VOLUME VII APPENDICES G AND H

SURFACE WATER HYDROLOGY

G-1 Potential Flood Impacts in the Laguna de Santa Rosa Floodplain and Russian River Floodplain
G-2 Potential Streambank Erosion-Laguna de Santa Rosa and Russian River

GROUNDWATER

H-1 Hydrogeology of Storage/Reuse Areas and Evaluation of Potential Impacts to Groundwater
H-2 Reclaimed Water Quality
H-3 Reclaimed Water Quality Update
H-4 Well Installation and Groundwater Monitoring Results
H-5 Irrigation Nitrogen Loading to Groundwater

VOLUME VIII APPENDICES I-1 THROUGH I-10

SURFACE WATER QUALITY

VOLUME IX APPENDICES I-11 THROUGH I-18

SURFACE WATER QUALITY, CONTINUED

VOLUME X APPENDICES J THROUGH K-1

PUBLIC HEALTH AND SAFETY

TERRESTRIAL BIOLOGICAL RESOURCES

VOLUME XI APPENDICES K-2 THROUGH K-4

TERRESTRIAL BIOLOGICAL RESOURCES, CONTINUED

VOLUME XII APPENDIX K-5

TERRESTRIAL BIOLOGICAL RESOURCES, CONTINUED

VOLUME XIII APPENDIX L

AQUATIC BIOLOGICAL RESOURCES

VOLUME XIV APPENDICES M THROUGH O

JURISDICTIONAL WETLANDS RESOURCES

TRANSPORTATION

AIR QUALITY

NOISE

No supporting documents produced.

VISUAL RESOURCES

No supporting documents produced.

VOLUME XV APPENDICES P THROUGH T

CULTURAL RESOURCES AND PALEONTOLOGY

PUBLIC SERVICES, UTILITIES, AND RECREATION

ENERGY

SOCIO-ECONOMICS

NEPA/CEQA REQUIRED SECTIONS

VOLUME XVI APPENDICES U-1 AND U-2 (NOT INCLUDED IN CD ROM)

FINAL SCOPING REPORT

VOLUME XVII APPENDIX U-3 (NOT INCLUDED IN CD ROM)

FINAL SCOPING REPORT

4.0 INTRODUCTION

This Chapter consists of 19 sections, each of which presents the analysis of the alternatives and components within an environmental discipline. Each section includes the following information:

- A short introduction.
- Impacts Evaluated in Other Sections: A summary of where to find topics associated with the section's analysis which are addressed elsewhere in the EIR/EIS.
- Affected Environment (Setting): A description of the existing conditions for each environmental discipline. The setting acts as a baseline to which the analysis compares the effects of the alternatives and components.
- Evaluation Criteria with Point of Significance: A table presenting the criteria used to determine specific impacts, measurements used to determine whether an impact is "significant," and the point at which the impact becomes significant (See Glossary, in Volume III, for a definition of "Significant.") The source and justification for each criterion is also identified in the table.
- Methodology: A brief description of how the impact analysis was done.
- Environmental Consequences (Impacts) and Recommended Mitigation: A presentation of the results of the environmental analysis for each discipline, including the identification of impacts, the determination regarding significance, the description of mitigation measures proposed to avoid or lessen impacts, and whether mitigation will reduce the effects to less than significant. These analyses are presented in the following order:
    - Component Impact Analysis; Each component's environmental impacts are assessed for each criterion. When impacts are identified a table is provided with the evaluation criterion, the point of significance, the impact the component would have on the environment, the type of impact (construction, operation and maintenance, permanent), and the level of significance. The level of significance identifies the level of the impact both before and after mitigation. For each criterion, an analysis of the expected impacts is presented and, if necessary mitigation measures for each impact are proposed. The complete text of each mitigation measure is presented in Chapter 2. No mitigation is proposed for impacts of the No Action Alternative, because CEQA requires mitigation only upon approval of a project.

- Impact and mitigation numbering:

A B C

Impact: **1.6.7. Will the pump station component convert public open space to project facilities?** D

Analysis: *Significant; Alternative 4.*

The site for pump station G-3 (Alternative 4) along Pine Flat Road is located on a property for which the Sonoma County Agricultural Preservation and Open Space District holds conservation easments...,

No Impact; Alternatives 1, 2, 3, and 5.

Pump stations for alternatives 2 and 3 are not located within a public open space.

Alternatives 1 and 5 do not have a pump station component. E

Mitigation: *Alternative 4.*

F G H

2.3.1. Replacement of Open Space Easements.

Alternatives 1, 2, 3 and 5. No mitigation is needed. I

After Mitigation: *Less than Significant after Mitigation; Alternative 4.*

Mitigation Measure 2.3.1 reduces this impact to a level below significance by providing funding to the Open Space District for the replacement on a one-for-one basis of existing ..., J

Key:

A - identifies the section (topic area) of the EIR/EIS: See Table of Contents for section numbering.
B - identifies the component that is being evaluated.
C - identifies the evaluation criterion.
D - identifies the impact being evaluated.
E - the determination of significance and explains the analysis and result by alternative.
F - indicates Chapter 2, Mitigation Monitoring Program.
G - identifies the section number of Chapter 2.
H - identifies the mitigation number in Chapter 2.
I - identifies mitigation proposed and indicates the mitigation number and type of mitigation. The full text of the mitigation measure is in Chapter 2.
J - describes the effectiveness of the mitigation measure and the resulting level of significance.

Component Numbering:

1 = No Action (No Project) Alternative
2 = Headworks Expansion Component
3 = Urban Irrigation Component
4 = Pipeline Component
5 = Storage Reservoir Component
6 = Pump Station Component
7 = Agricultural Irrigation Component
8 = Geysers Steamfield Component
9 = Discharge Component

- Cumulative Impact Analysis: Cumulative impacts are defined as two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts. These analyses evaluate the impacts from cumulative projects when added to Project impacts. The cumulative projects study area is defined in Section 3.6 of the Description of Existing System and Alternatives. Cumulative projects considered in this evaluation are identified in the Cumulative Projects List (Appendix D-31 of the Draft EIR/EIS).

- Summary of Significant Impacts and Mitigation Measures: A table which identifies all component impacts determined to be significant before mitigation and the mitigation measures proposed for each impact.

- Summary of Impacts by Alternative: A table which aggregates the results of the component impact analysis by alternative.

An exception to this format is the Socio-economics section, 4.19, which analyzes impacts only by alternative, not by component. This is necessary because the effects of the alternatives, taken as a whole are the issues of concern.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

4.1 LAND USE

This section discusses the consistency of the Project with existing and planned land uses and existing zoning. The section also discusses impacts on public open space and planning designations for mineral, aggregate, or geothermal resources. To provide a basis for this evaluation, the setting section provides information on regional land use patterns, General Plans of the jurisdictions within the study area, and existing and planned land uses within the vicinity of Project components.

IMPACTS EVALUATED IN OTHER SECTIONS

The Land Use Section covers only issues specifically related to land use planning. It does not cover associated topics such as agricultural land, noise, traffic, housing, or visual impacts. The following items are related to the Land Use Section but are evaluated in other sections of this document:

- Public Policies. This Land Use Section evaluates consistency of the Project with General Plans and other public policy documents regarding land use issues only. Public policies regarding, for example, biological or visual resources are treated in the Biological Resources or Visual Resources sections of this document.
- Growth Inducement. The issue of growth inducement resulting from the Project is addressed in Chapter 5 of this document.
- Conversion of Agricultural Land. Construction of Project facilities could result in the conversion of agricultural land and/or the cancellation of Williamson Act contracts covering existing agricultural operations. These potential impacts are discussed in Section 4.2, Agriculture. Impacts related to changes in type of agricultural operations resulting from the availability of reclaimed water for irrigation (e.g., conversion of grazing land to viticulture) are discussed in Section 4.18, Socio-economics.
- Viewsheds and Scenic Corridors. Construction of Project facilities including dams, pump stations, electrical service, and roadways could impact existing views and the visual quality of scenic roads and corridors. Impacts of the proposed Project facilities on visual resources are discussed in Section 4.14, Visual Resources.
- Loss of Dwelling Units. Construction of storage reservoirs would cause the loss of dwelling units. This impact is evaluated in Section 4.18, Socio-economics.

AFFECTED ENVIRONMENT (SETTING)

Jurisdictions potentially affected by the Project alternatives include the counties of Sonoma and Marin; the cities of Santa Rosa, Rohnert Park, Cotati, Sebastopol, and Petaluma; and the Town of Windsor. The City of Healdsburg's planning jurisdiction is located three miles from the nearest Project component and therefore would not be affected.

Planning Jurisdictions

All of the jurisdictions potentially affected by the Project alternatives have adopted General Plans, which include land use goals, objectives, and policies as well as a Land Use Plan map showing future land use designations (see Figure 4.1-1).

Sonoma County

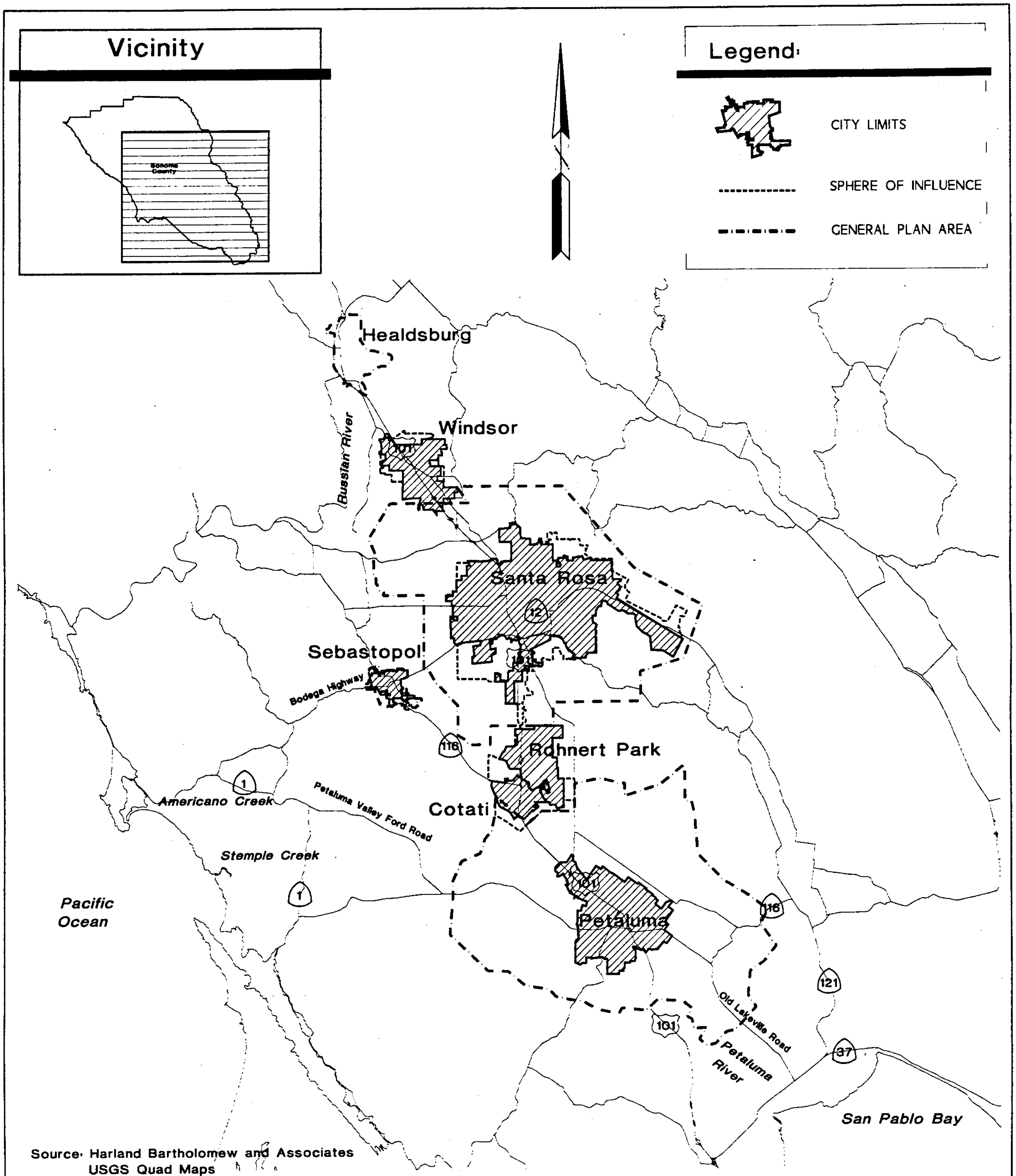
The Sonoma County General Plan (1989, revised 1991) is applicable to the unincorporated areas of Sonoma County and is intended to guide decisions regarding future growth, development, and conservation of resources through the year 2005. The General Plan divides the County into nine Planning Areas (also termed Sub-county Planning Regions) each with its own goals, objectives, and policies (see Figure 4.1-2).

Marin County

The Marin Countywide Plan (1994) applies to the unincorporated areas of Marin County and is intended to define a countywide character and development pattern, and establish a framework for coordinated planning and growth management in the County for the period of 1990-2010. The Community Development Element of the Plan divides the County into six Planning Areas, with more detailed objectives and policies for each area. The West Marin Planning Area includes the portion of the County potentially affected by Project alternatives.

Santa Rosa

Santa Rosa is the county seat of Sonoma County and, with a population of about 126,000, is the largest city in the County. The Santa Rosa General Plan (1991, amended 1994) is intended to provide for the orderly development of the City and the conservation of its natural and historical resources through the year 2010. The Land Use Element of the Plan includes land use policies and land use designations applicable to the area within the present city limits and also to areas outside the present limits but within a future urban boundary designated in the Plan. Outside the urban boundary, the Plan defines a planning area, within which the City has no existing or future jurisdiction (see Figure 4.1-1).



Source: Harland Bartholomew and Associates
USGS Quad Maps

HARLAND BARTHOLOMEW and ASSOCIATES, INC.
A UNIT OF PARSONS INFRASTRUCTURE and TECHNOLOGY GROUP INC.
PARSONS

Santa Rosa
Subregional Long-Term
Wastewater Project

Figure 4.1-1

MUNICIPAL
PLANNING JURISDICTIONS

Sebastopol

Sebastopol is located west of Santa Rosa on rolling land between the Laguna de Santa Rosa on the east and Atascadero Creek and functions as a market center for western Sonoma County from the Russian River south to Marin County. The Sebastopol General Plan (1994) establishes the City's environmental, social, and economic goals, as well as the location and intensity of different land uses for a 20-year period from 1994 to 2014. The General Plan is applicable within the city limits and the adjoining unincorporated areas within the City's sphere of influence (see Figure 4.1-1).

Rohnert Park

Rohnert Park is located half way between Santa Rosa and Petaluma on flat land with a gentle downslope to the northwest and is immediately adjacent to Cotati. Rohnert Park, founded in 1956, is one of the newest communities in Sonoma County, and its land use patterns were generally guided by the original master plan for the community. The Rohnert Park General Plan (1995) provides guidelines for the physical development of the City and is applicable within the city limits and the adjoining unincorporated areas within the City's sphere of influence. The General Plan also identifies a larger planning area extending beyond the sphere of influence (see Figure 4.1-1).

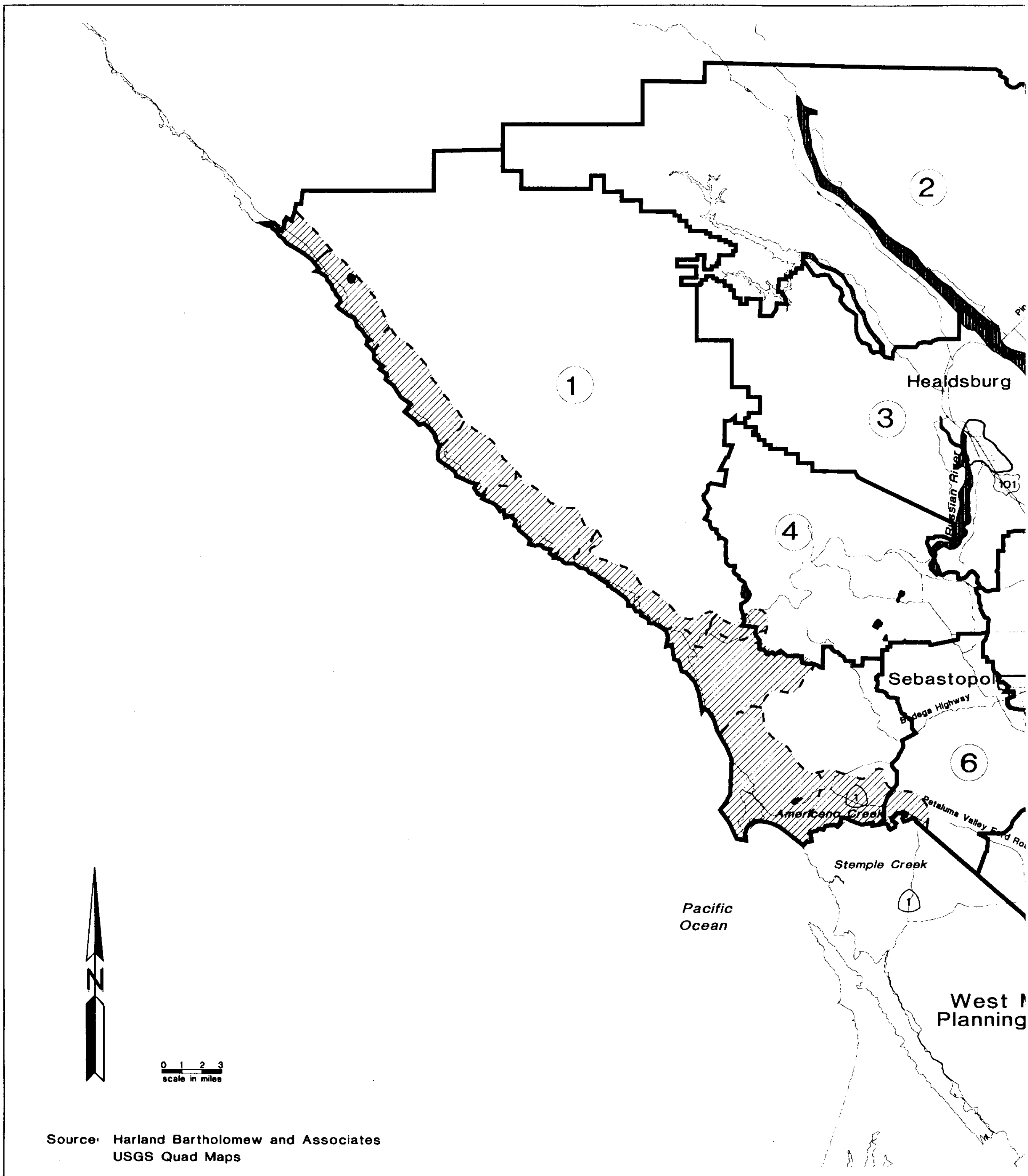
Cotati

Cotati is located at the southern end of the Santa Rosa Valley, in gently rolling hills immediately adjacent to Rohnert Park and separated from Petaluma by Meacham Hill.

The Cotati General Plan (1989) provides guidelines for the growth and development of the City in the period 1985 to 2005. The General Plan is applicable within the city limits and the adjoining unincorporated areas within the City's sphere of influence (see Figure 4.1-1).

Petaluma

Petaluma is located in the southern portion of Sonoma County, and lies in a bowl defined by Sonoma Mountain on the east and the low coastal foothills on the west. The City is divided by Highway 101 and the Petaluma River. The East Side, developed since the 1960s, is characterized by tract subdivisions and a marked contrast with adjacent agricultural lands, while the West Side, which includes the downtown area, is more varied in character, with residential areas becoming more rural in character west of the City. The Petaluma General Plan (1987, revised 1993) identifies development policies for the City and its planning referral area for the period 1987 to 2005. The Planning Referral Area, delineated as the

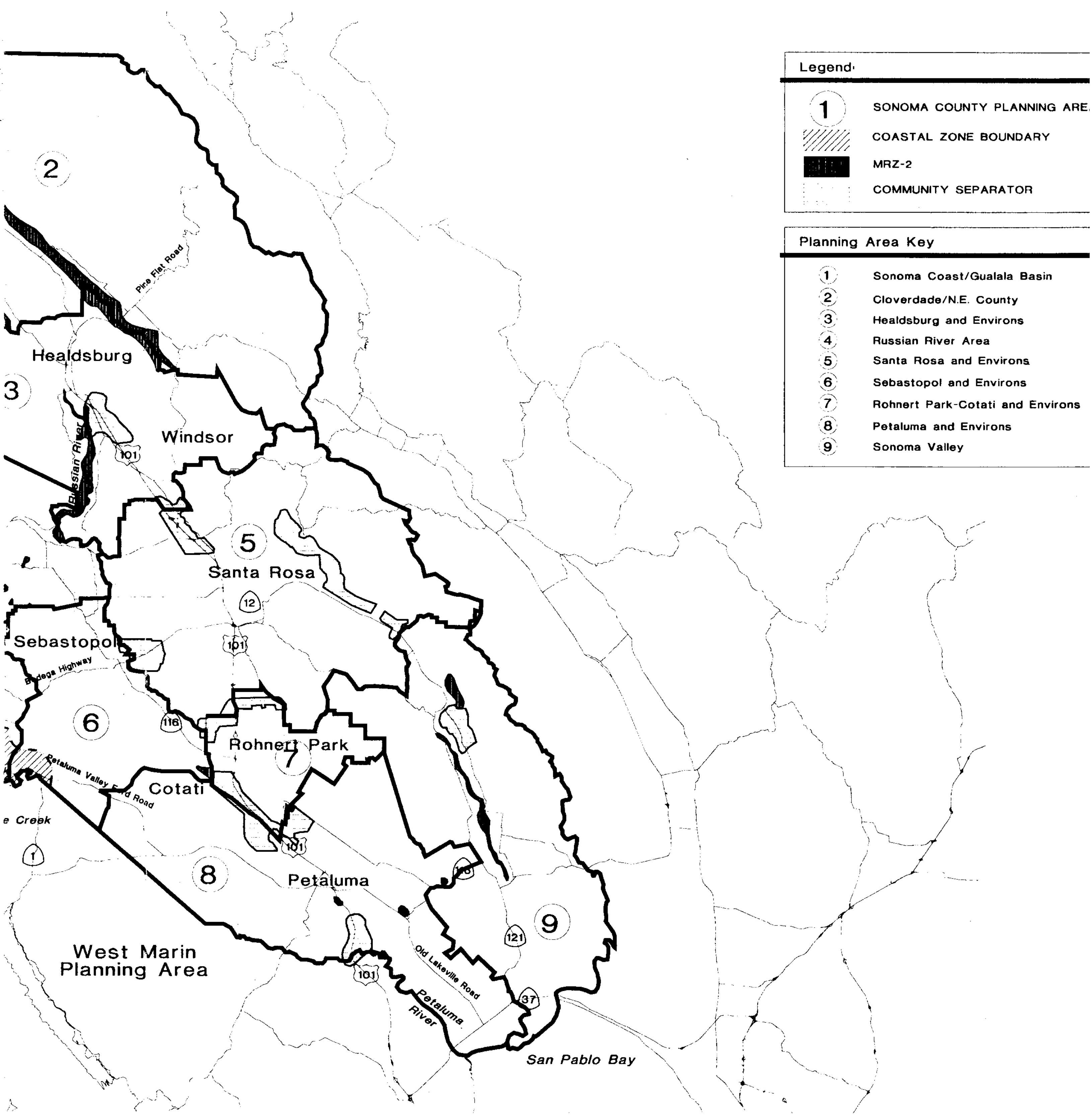


Source: Harland Bartholomew and Associates
USGS Quad Maps

HARLAND BARTHOLOMEW and ASSOCIATES, INC.
A UNIT OF PARSONS INFRASTRUCTURE and TECHNOLOGY GROUP INC.
PARSONS

Santa Ros

1



ta Rosa

Subregional Long-Term
Wastewater Project

Figure

PLANNING ARE

2

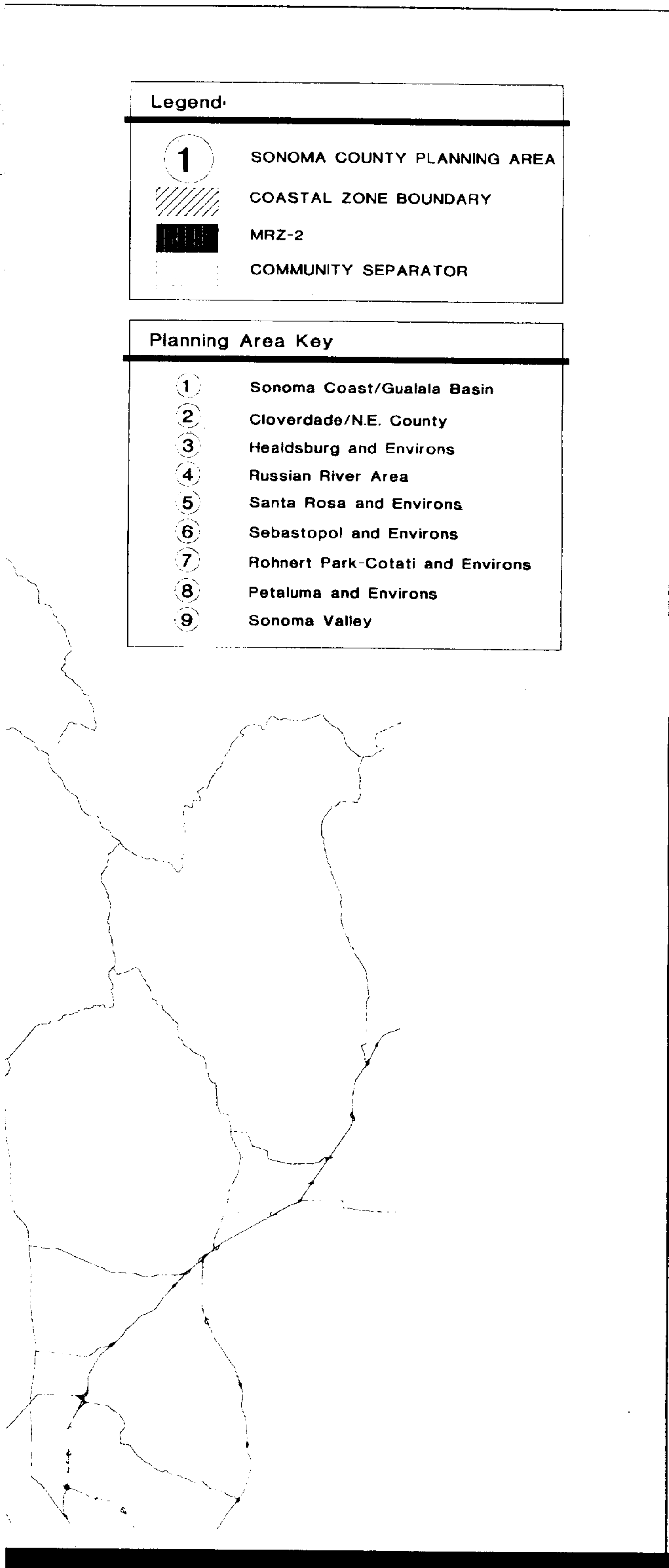


Figure 4.1-2

PLANNING AREAS

3

General Plan Area on Figure 4.1-1 encompasses the area within the Petaluma River watershed. An urban limit line is also established by the General Plan.

Windsor

The Town of Windsor, located between Santa Rosa and Healdsburg, was incorporated in 1992 and adopted its first General Plan in March 1996. Windsor is a predominantly residential community centered around U.S. 101 and Old Redwood Highway. A mix of land uses is found along Old Redwood Highway, with several new commercial centers changing the character of the area. The more recent residential development is visually distinct from the older residential areas and is characterized by tract subdivisions that are generally enclosed by walls. Industrial development in the Town includes portions of the Airport Business Park along Shiloh Road. Hills and ridges to the east, west, and north enclose the Town's relatively level terrain at the northern end of the Santa Rosa Plain. The General Plan Planning Area is generally bounded by the Russian River to the west, a ridgeline to the north, PG&E transmission lines to the east, and Airport Creek to the south (See Figure 4.1-1).

Regional Land Use Patterns

Existing Land Use

Existing land use patterns in Sonoma County are generally characterized by city- and community-centered growth, with areas of agricultural use and other open space separating the cities and communities. The study area includes the unincorporated communities of Graton, Valley Ford, Bloomfield, Two Rock, and Penngrove. These communities consist of rural residential development intermixed with grazing, farming, and other agricultural activities. Some communities such as Graton, Valley Ford, and Penngrove also have small commercial centers providing services for the local area. Within the city and community areas, there exists a wide variety of density of development, ranging from highly urban to semi-rural, typically with larger lots around the fringe of the incorporated areas and in the unincorporated communities.

Agriculture is an important land use in the County, with a diversity of agricultural operations, including vineyards, orchards, dairies, forage crops, specialty crops, and livestock. Other natural resource uses, such as timberlands and the mining of aggregates, are also important elements of the overall land use patterns in portions of the County. Along the Pacific Coast, fishery uses are significant, while major recreation and tourism uses occur along the coast and the Russian River.

In western Marin County, land use patterns are related to the coastal-recreation and inland-rural corridors defined in the Countywide Plan. Agricultural and natural resource related uses predominate within the Project area.

Planned Land Use

Planned land uses which may be affected by the Project are those designated in the adopted General Plans of the Counties of Sonoma and Marin, the Cities of Santa Rosa, Rohnert Park, Cotati, Sebastopol, and Petaluma and the Town of Windsor. In addition, the Sonoma Coastal Plan and Marin Coastal Program identify recommended land uses and policies for lands within the designated Coastal Zone.

Generally, the planned land use patterns at the countywide level reflect existing development patterns. In Sonoma County, planned land uses are based upon focused growth within relatively compact city and community areas, with community separators to maintain the separate identities of the major cities in the County. Outside the planned urban growth areas, land uses within the County are also planned to be of low intensity, with emphasis upon protection of agriculture and preservation of scenic or biotic resources.

Planned land use in western Marin County is also predominantly agriculture or conservation. Along the northern border adjoining Sonoma County, planned land uses are agricultural, typically with a density of one dwelling unit per 30 to 60 acres, consistent with the character of the inland-rural corridor through this part of the County (see Figures 4.1-3a, b, c).

Project Area Land Use

The Project components encompass a large geographic area in Sonoma County and a portion of northern Marin County. Project components extend from the lower elevations of the Sonoma Mountains on the east to Valley Ford on the west, and from the geysers on the north to the Chileno Valley and the San Pablo Bay Flats on the south. Specific geographic areas within the study area are described in the following sections.

Santa Rosa Plain

This portion of the Project area, located between the City of Santa Rosa's urban boundary on the east and the Laguna de Santa Rosa on the west and south and extending north to Mark West Creek, is primarily agricultural in character, the easterly portions, which are rural residential in character, are located within close proximity to urban development in Santa Rosa and Rohnert Park (see Figures 4.1-3a, b, c).

Agricultural uses in the vicinity of Project components are varied, with grazing predominant, but also including viticulture, row cropping, and diverse specialty agriculture. These agricultural areas vary in size, with many smaller parcel sizes interspersed among the larger holdings. Also scattered among the agricultural areas are rural residential uses and residential uses associated with agricultural operations. More extensive areas of rural residential use are located to the east of

the agricultural areas along Stony Point Road and Wright Road, as well as in the vicinity of Guerneville and Olivet Roads.

Other land uses are public/semi-public or recreational uses and a limited number of industrial and commercial uses adjacent to Highway 12 between the Laguna and Llano Road. A small local commercial area is located at the intersection of Stony Point Road and Todd Road. The major public use in the area is the Laguna Plant located on Llano Road, while other public/semi-public uses (such as schools and religious buildings) are scattered within the rural development. The Santa Rosa Country Club is located south of Hall Road.

Planned land uses in the vicinity of Project components generally maintain the existing land use patterns, and zoning classifications are consistent with the planned land use designations. Areas within unincorporated Sonoma County are designated primarily for non-urban uses under the Sonoma County General Plan, including Agricultural and Rural Residential. Future land use designations for the City of Santa Rosa's Planning Area outside the Urban Boundary are non-urban and consistent with the Sonoma County General Plan.

Fountaingrove Area

Existing land use in the Fountaingrove area consists of a wide variety of uses, including residential, commercial, recreational and industrial. Existing land uses on the proposed urban irrigation sites are predominantly public facilities, except for the Fountaingrove sites, where the uses consist of a private golf course, offices and related uses. Uses at the Cloverleaf Ranch site, located north of the Fountaingrove development along Old Redwood Highway in unincorporated Sonoma County, consist of a youth camp, riding academy, and daycare facilities.

Planned land uses in the vicinity of Project components exhibit the diverse existing character of development, with a variety of urban designations under the City of Santa Rosa General Plan. The Cloverleaf Ranch site is designated as Resources and Rural Development under the Sonoma County General Plan.

Bennett Valley/East Santa Rosa Area

Existing land use in the vicinity of Project components in this area, located generally along the Highway 12 corridor and Bennett Valley Road, is primarily residential. A major community commercial area, including Montgomery Village, is located west of the Montgomery High School site. The Luther Burbank Gardens are located just south of the Santa Rosa central business district. Other major public land uses are the Sonoma County Fairgrounds and the Bennett Valley Golf Course.

Planned land use in the vicinity of Project components in this area exhibits the diverse existing character of development, with a variety of urban designations under the City of Santa Rosa General Plan.

Rohnert Park/Cotati Urban Area

Existing land use patterns within Rohnert Park and Cotati are typified by compact urban development. Residential uses, along with local commercial areas and public and institutional uses (schools, parks, and churches) predominate outside the Highway 101 corridor. More intensive commercial and industrial development is found along the Highway 101 corridor.

Planned land uses within the cities of Rohnert Park and Cotati consist of residential uses, local and community commercial centers, and public and semi-public use areas.

East of Rohnert Park and Cotati

Existing land use in the vicinity of Project components in this area is mixed low density residential and agricultural. Agricultural uses include both crops and grazing. Adjacent to this area is the unincorporated community of Penngrove, which is primarily residential with a small commercial area on Main Street south of Adobe Road. Also to the east of Project agricultural irrigation areas, going up the west slope of Sonoma Mountain are areas of rural residential use. Other residential uses in the area are associated with agricultural operations. Major public land uses in the vicinity are Sonoma State University and Crane Creek Regional Park.

Planned land use and zoning classifications within the study area exhibit the existing character of development, with Diverse Agriculture and Rural Residential designations under the Sonoma County General Plan (see Figures 4.1-3a, b, c).

North of Petaluma

Existing land use in the vicinity of Project agricultural irrigation areas north of Petaluma is mixed low density residential and agricultural. Agricultural uses include both crops and grazing. Adjacent to this area is the commercial/industrial area at Stony Point Road and North Petaluma Boulevard, just west of the Highway 101/Old Redwood Highway interchange.

Planned land use and zoning classifications exhibit the existing character of development, with a combination of Land Extensive Agriculture, Diverse Agriculture, and Rural Residential designations under the Sonoma County General Plan. This area also is within the City of Petaluma's Planning Referral Area and adjacent to the City's Urban Limit Line. Within the Petaluma Urban Limit Line, the City's General Plan designates land adjacent to Project agricultural irrigation areas as Agricultural, providing a transition to more intensive industrial, residential, and commercial designations.

Petaluma Urban Area

The existing development within the Petaluma area is well established and defined by the urban separator, a visible band of open space, which is continuous on the east side, parallel to Adobe Road. Downtown Petaluma, west of the Petaluma River, is the primary commercial and cultural center, while higher intensity development including other commercial centers and industrial uses follows the Highway 101 and Lakeville Highway corridors. Development to the east of these corridors is primarily residential, with interspersed public/semi-public uses (such as schools and parks) and a limited number of local retail centers. Along the eastern edge of this urban development, between Washington Street and Casa Grande Road, is the Petaluma Municipal Airport, which is the major public use in the eastern part of the City. Along the western side of the City are areas of lower density suburban and rural residential uses.

Planned land uses in the Petaluma General Plan maintain the existing established pattern of development, with higher intensity uses in the downtown area and along the Highway 101 and Lakeville Highway corridors. There is a continuous Urban Separator designation maintaining a band of open space along the eastern border of the urban area. There is also an intermittent Urban Separator designation along the western border of the area from Western Avenue to South Petaluma Boulevard.

Adobe Road Area

Existing land use is mixed low-density residential and agricultural, with agricultural uses consisting primarily of grazing operations. Areas to the west of Adobe Road are also predominantly agricultural, and urban development in the City of Petaluma extends westerly from the Municipal Airport.

Planned land use maintains the existing character of development, with primarily Extensive Agriculture and Rural Residential designations under the Sonoma County General Plan (see Figures 4.1-3a, b, c).

Lakeville Area

Existing land use is predominantly agricultural, including both crops and grazing. Residential uses typically are associated with the agricultural operations. There are scattered, isolated commercial uses along Lakeville Highway; generally, these uses are also associated with agricultural operations. To the north of Stage Gulch Road on the west side of Lakeville Highway is the City of Petaluma's wastewater treatment facility.

Planned land use and zoning classifications exhibit the existing character of development, with both Diverse Agriculture and Land Extensive Agriculture designations under the Sonoma County General Plan (see Figure 4.1-3).

West of Sebastopol

Existing land use is a mixture of rural residential and agricultural uses with diverse crops (including vineyards and orchards). The area surrounds the community of Graton, which contains more intensive residential development as well as industrial and limited commercial uses. Non-residential uses outside of Graton, such as those in the Barlow and Molino areas along Occidental Road, are typically associated with the agricultural economy of the area. Lands to be considered for agricultural irrigation within this area are generally in agricultural use, although some land is not currently being cropped.

Planned land use and zoning classifications exhibit the existing character of development, with Diverse Agriculture and Rural Residential designations under the Sonoma County General Plan (see Figures 4.1-3a, b, c).

Stemple Creek and Americano Creek Area

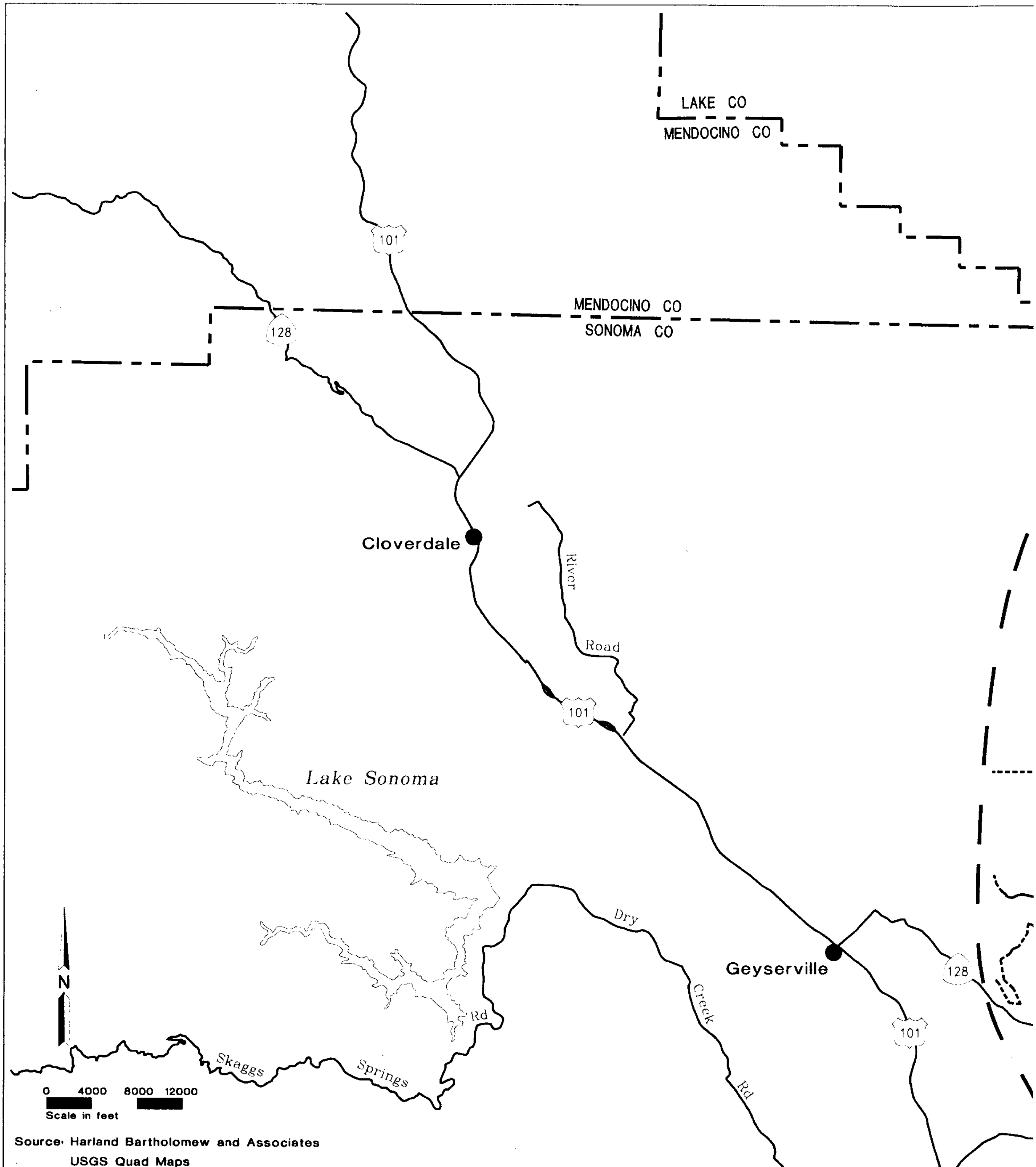
Existing land use is primarily agricultural, with most agricultural lands devoted to grazing. Within this area is the unincorporated community of Bloomfield, which is residential with a small commercial area on Bloomfield Road. Areas to the north on English Hill are low-density rural residential in character. Major public land uses in the vicinity are the Sonoma County landfill site on Meacham Road and the Coast Guard Training Center on Tomales Road.

Planned land use and zoning classifications exhibit the existing character of development, with Land Extensive Agriculture designations under the Sonoma County General Plan (see Figures 4.1-3a, b, c). Land use designations under the Marin County General Plan (Northwest Marin County Land Use Policy Map) are Agricultural.

Russian River Area

Existing land use along the Russian River between Mark West Creek and Windsor Station Road is predominantly agricultural with a combination of viticulture, row crops, and grazing. There are scattered residences in the area generally associated with the agricultural operations. Downstream from the proposed discharge location are the Russian River resort communities extending from Mirabel Park to Monte Rio.

Planned land use in the vicinity of Project components along the Russian River is consistent with existing uses, consisting of the Resources and Rural Development designation under the Sonoma County General Plan (see Figures 4.1-3a, b, c).



Source: Harland Bartholomew and Associates
USGS Quad Maps

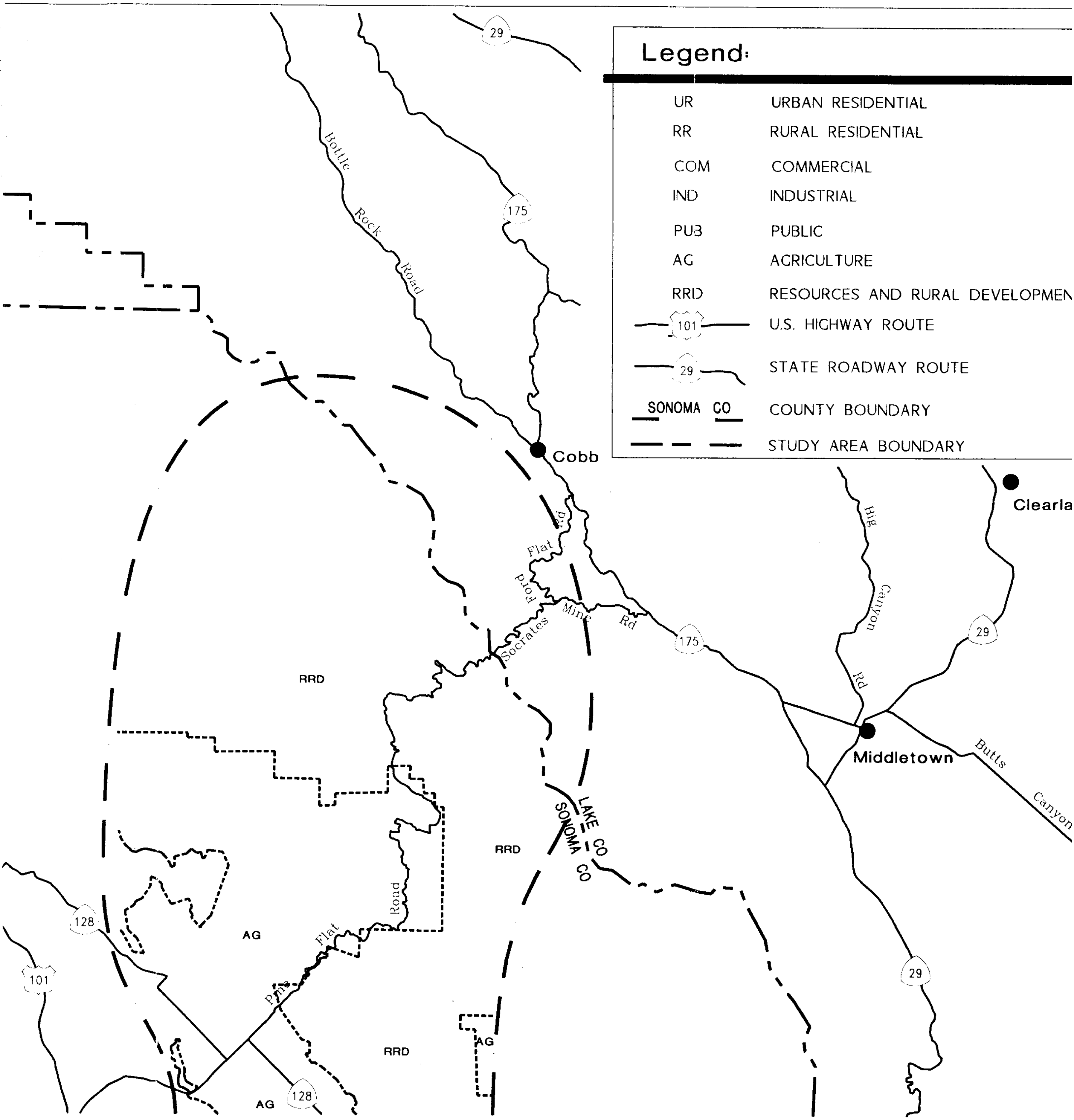
HARLAND BARTHOLOMEW and ASSOCIATES, INC.

A UNIT OF PARSONS INFRASTRUCTURE and TECHNOLOGY GROUP INC.

PARSONS

Santa Rosa

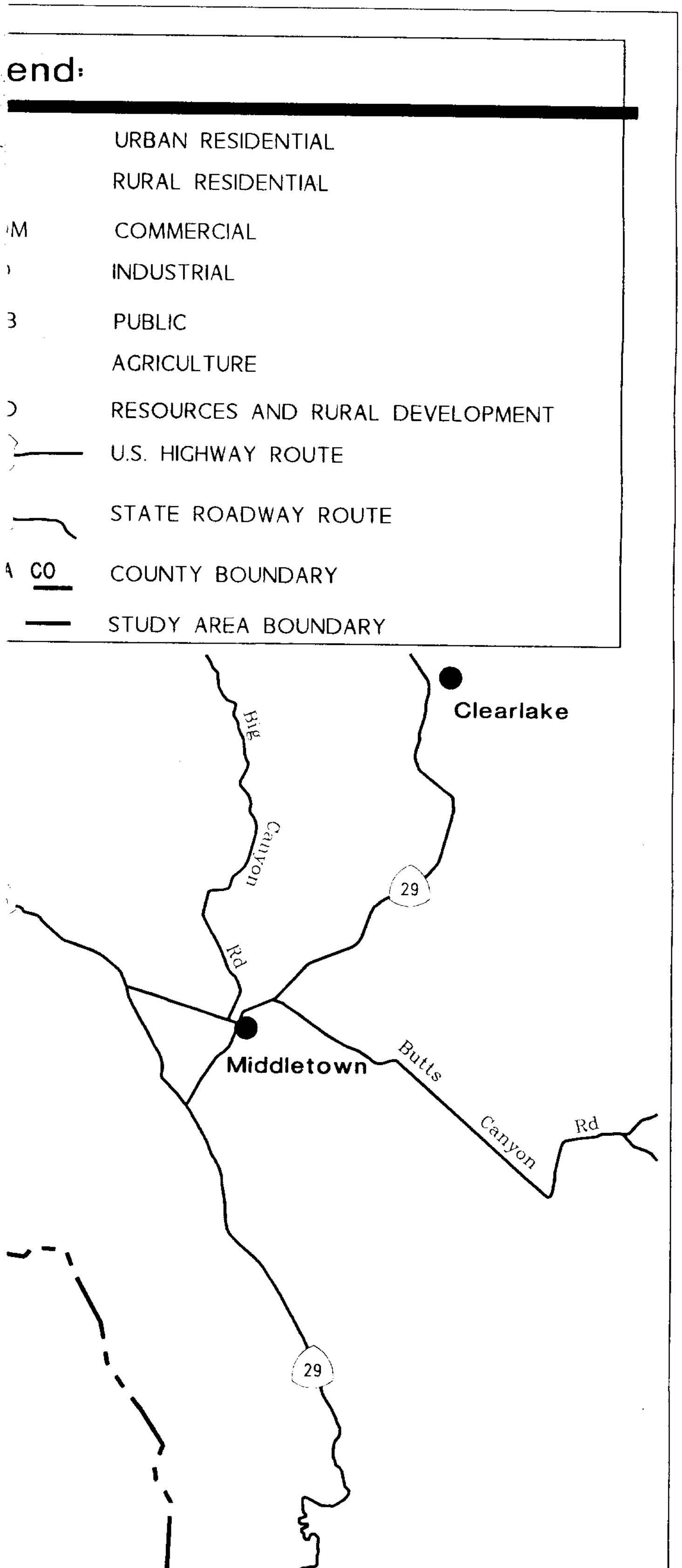
(1)



Subregional Long-Term Wastewater Project

SONOMA COUNTY/
MARIN COUNTY
PLANNED LAND USE

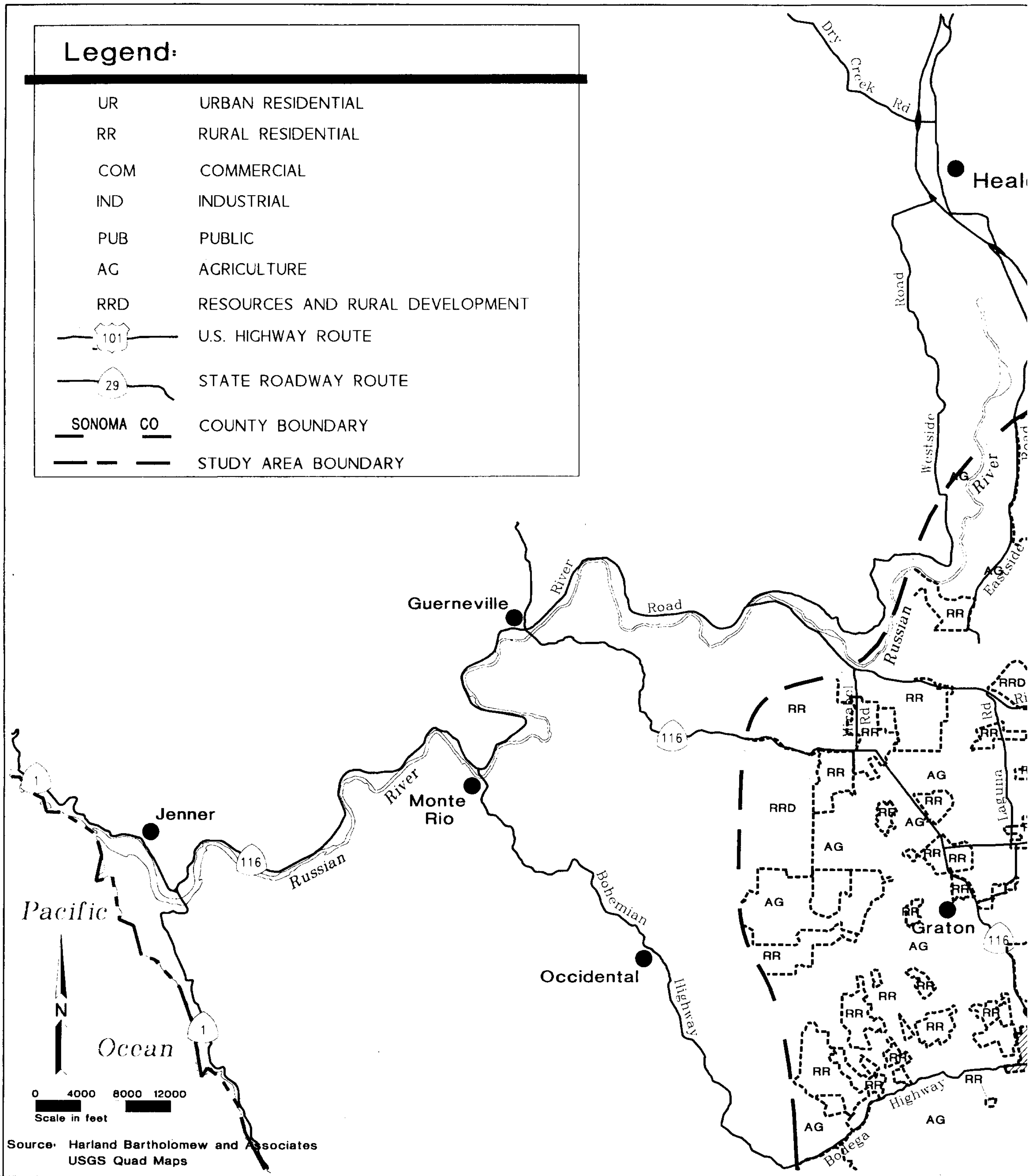
Figure



ONOMA COUNTY/
ARIN COUNTY
LANNED LAND USE

Figure 4.1-3a

3

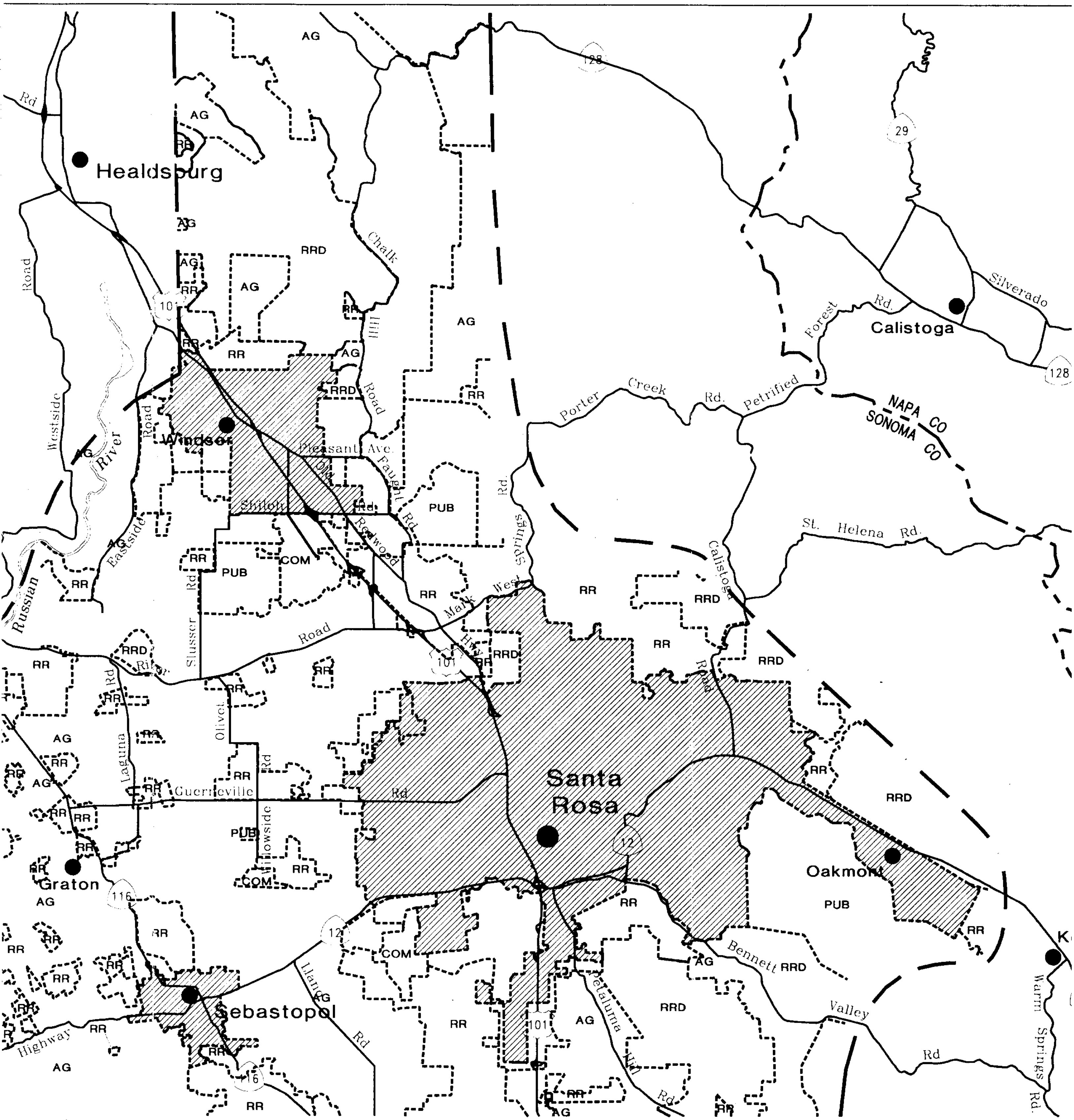


HARLAND BARTHOLOMEW and ASSOCIATES, INC.

A UNIT OF PARSONS INFRASTRUCTURE and TECHNOLOGY GROUP INC.

PARSONS

Santa Ros



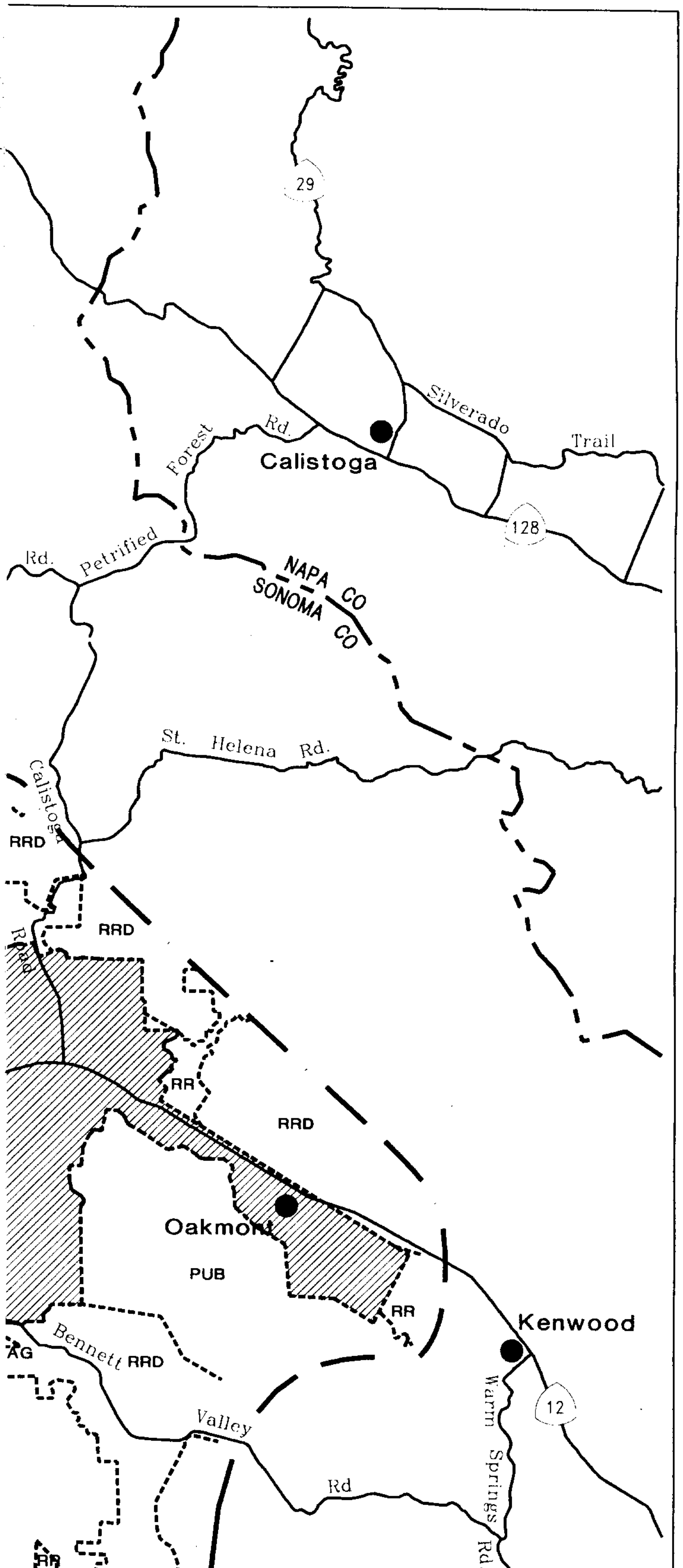
ta Rosa

Subregional Long-Term
Wastewater Project

SONOMA COUNTY/
MARIN COUNTY
PLANNED LAND USE

Figure

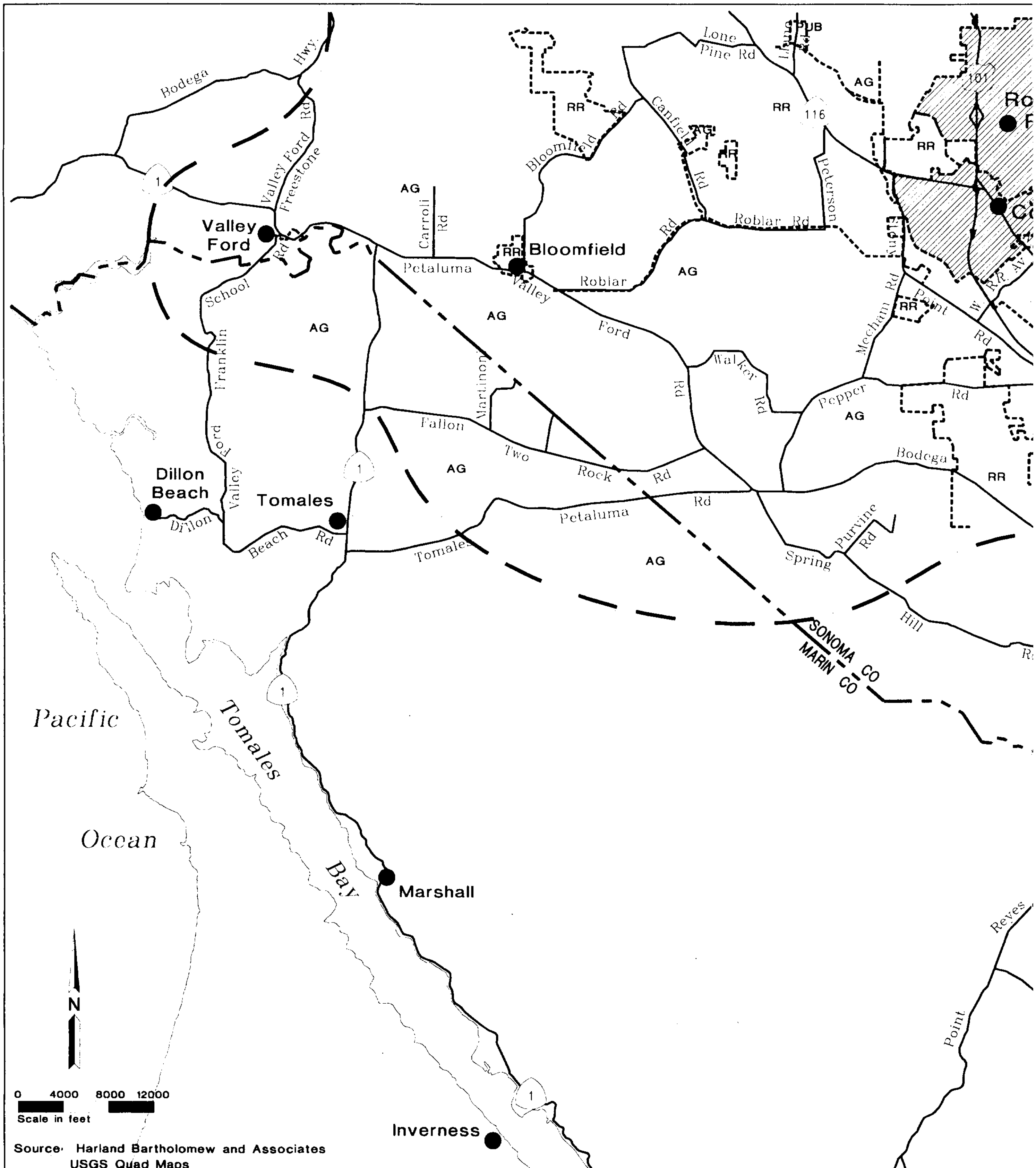
2



ONOMA COUNTY/
'ARIN COUNTY
LANNED LAND USE

Figure 4.1-3b

(3)

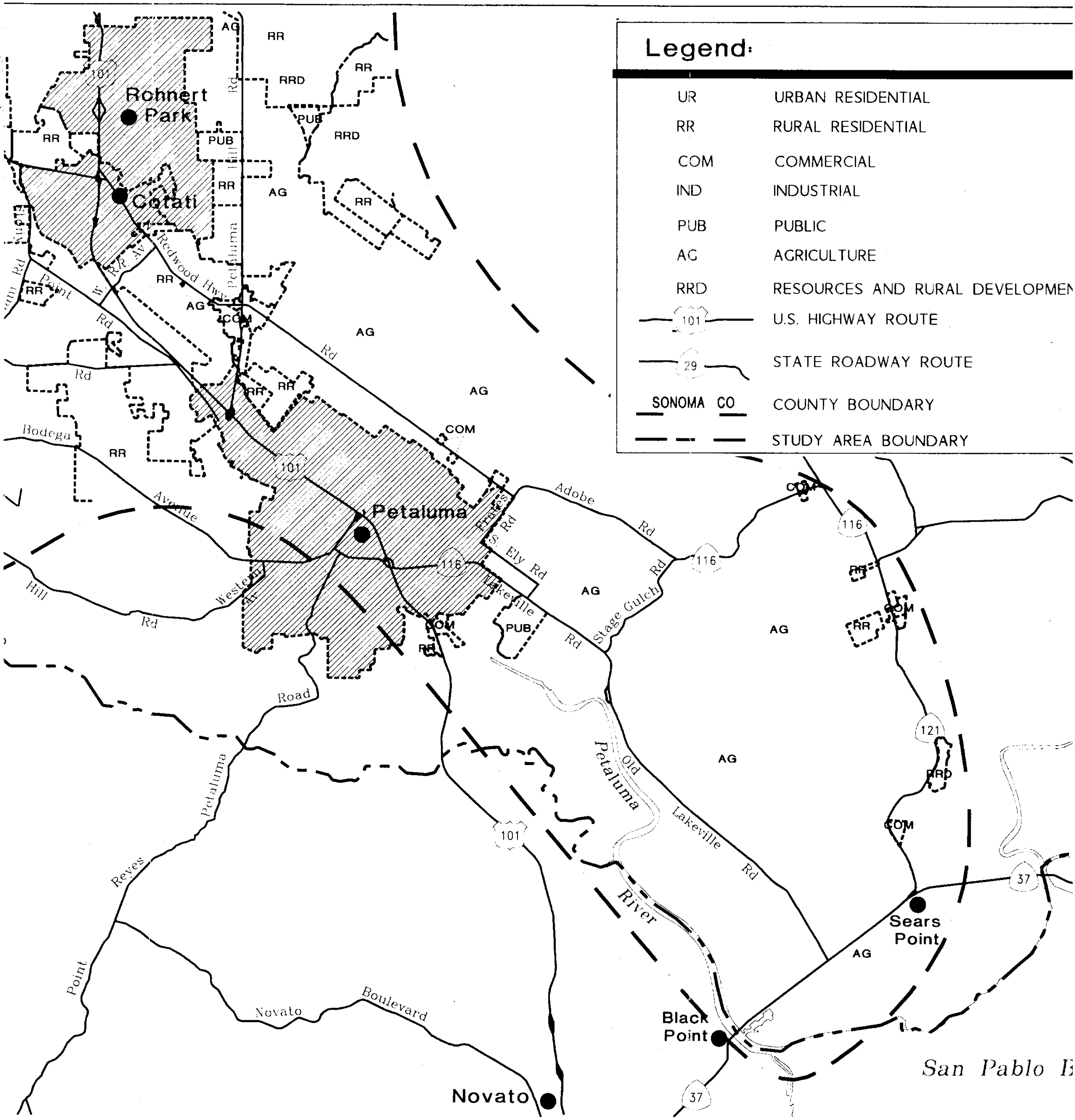


HARLAND BARTHOLOMEW and ASSOCIATES, INC.

A UNIT OF PARSONS INFRASTRUCTURE and TECHNOLOGY GROUP INC.

PARSONS

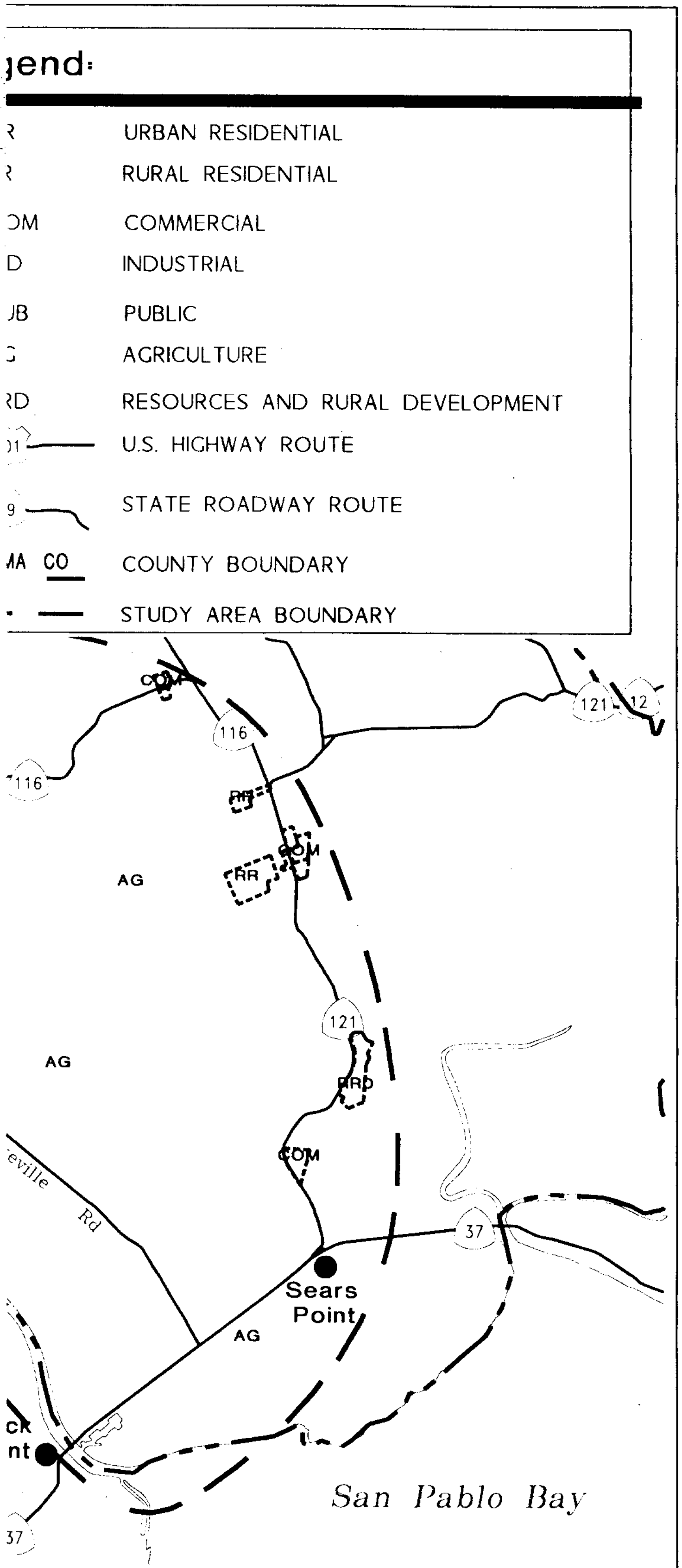
Santa Rosa



Subregional Long-Term Wastewater Project

SONOMA COUNTY/ MARIN COUNTY PLANNED LAND USE

Figure



ONOMA COUNTY/
ARIN COUNTY
LANNED LAND USE

Figure 4.1-3c

3

Geysers Pipeline Area

Existing land use along the pipeline route from the Santa Rosa Plain to the geysers reflects the varied geographic character along the route. From Mark West Creek to the Sonoma County Airport, the land use pattern is primarily agricultural, with scattered residences associated with agricultural use. The route passes along the west side of the Sonoma County Airport, and there is a cluster of rural residential development to the northwest of the Airport along Mark West Springs Road. East of the Airport to Highway 101 is an area of mixed industrial and commercial use. From Highway 101 to Chalk Hill Road the route passes through the Town of Windsor, with urban residential uses predominating. Along Chalk Hill Road, from Windsor to Highway 128, uses are primarily resource-related, with viticulture, other agricultural uses, and scattered residential uses. Along Highway 128, through the Alexander Valley to Pine Flat Road, viticulture is the dominant use, again with scattered residential uses. Along Pine Flat Road to the geysers, the land is primarily undeveloped, although there are isolated residences and ranches.

Planned land uses and zoning along the pipeline route maintain the existing land use patterns, with a variety of designations under the Sonoma County General Plan (see Figures 4.1-3a, b, c). Within the Town of Windsor, urban residential uses predominate.

Geysers Steamfield

Existing land use in the geysers geothermal steamfield area is related to the operation of the existing geothermal steamfields, including facilities such as well heads, power plants, and electrical utility and communications facilities.

Planned land use in the geysers steamfield area is the Resources and Rural Development designation under the Sonoma County General Plan. The zoning classifications are consistent with this designation.

Community Separators

The Sonoma County General Plan identifies eight Community Separators to maintain community identity and prevent the merging of cities and communities into continuous areas of urban development without visual relief. These Community Separators are also incorporated into the land use policies and designations of the municipalities within the County. The separators are planned for low intensities of use which do not require urban services. Commercial and industrial uses in the separators are intended to be those related to agricultural and resource land use categories. The following Community Separators, shown in Figure 4.1-2, are potentially affected by the Project:

- Santa Rosa-Windsor Community Separator along Highway 101;

- Santa Rosa-Rohnert Park Community Separator along the northern boundary of the Rohnert Park urban service area;
- Petaluma-Rohnert Park Community Separator along Highway 101; and
- Sebastopol-Santa Rosa Community Separator along the Laguna de Santa Rosa.

The existing character of these areas is non-urban, with rural residential and agricultural uses predominating.

Mineral, Aggregate, and Geothermal Resource Areas

California Surface Mining and Reclamation Act

Under the California Surface Mining and Reclamation Act of 1975, the State Geologist classifies land in the State for its mineral resource potential according to various Mineral Resource Zone (MRZ) categories that reflect varying degrees of mineral potential. Within the study area, there are significant mineral resources identified in the Resource Conservation Element of the Sonoma County General Plan as Mineral Resource Deposits subject to resource conservation policy requirements under the MRZ-2 classification. The MRZ-2 classification includes areas where geologic data indicate significant measured, indicated, or inferred resources.

MRZ-2 designations are shown on Figure 4.1-2. The largest areas of such designations potentially affected by the Project consist of deposits along the Russian River in the Alexander Valley and south of Healdsburg and along Green Valley Creek northwest of Sebastopol. Other MRZ-2 areas are located along Highway 116 east of Petaluma and along Stony Point Road southeast of Sebastopol.

Sonoma County Aggregate Resources Management Plan

The Sonoma County Aggregate Resources Management (ARM) Plan establishes policies and standards for the management of the County's aggregate resources (County of Sonoma 1994). One of the objectives of the ARM Plan is to increase quarry production to provide a full range of uses and replace river terrace sources as the primary supply for future construction aggregate. The ARM Plan designates seven new quarry sites in the County as well as expansion areas for most existing quarries. Sites designated in the ARM Plan within the study are a are: the Walker Road site, a potential new quarry located Two Rock reservoir site; and the Ielmorini Quarry, a permitted, but undeveloped, quarry on the Adobe Road reservoir site.

The ARM Plan indicates that all designated new quarry sites and potential expansion areas shall be protected from incompatible uses by being considered in the review of all nearby development proposals; and that uses which would be

incompatible with future quarry development on designated sites shall not be permitted unless the public benefits of the proposed use outweigh the public benefits of the potential quarry development. The ARM Plan also identifies Potential Quarry Resource Areas. These Potential Quarry Resource Areas are for informational purposes only and do not restrict other uses allowed by zoning. The development review process need not consider potential quarry resources in these undesignated areas.

Sonoma County Geothermal Resources Management Plan

The Sonoma County Geothermal Resources Management Plan (1990) (GRMP) is intended to work in conjunction with the Resource Conservation Element of the Sonoma County General Plan and set policies and guidelines for the utilization and management of the County's geothermal resources, particularly the geysers Known Geothermal Resource Area (KGRA), while minimizing environmental and land use conflicts. Sonoma County's policy, reflected in the County's general plan, is to promote geothermal development within the primary resource area of the geysers, which consists of about 35,000 acres including the existing geysers operations. The Management Plan is based upon full-field development, which promotes development while protecting cultural and environmental values.

Under the Land Use section of the GRMP, lands within the GRMP area (which corresponds to the primary resource area of the geysers) are designated geothermal resources to protect and promote the management of resources. The Plan provides that the primary use of lands shall be geothermal management and production activities, including geothermal resource exploration activities, geothermal power generation facilities, and related transmission facilities.

Coastal Zone

The Sonoma County Coastal Zone includes portions of the Estero Americano extending east of Valley Ford, to a few hundred feet east of Highway 1 (see Figure 4.1-2). The Sonoma County Coastal Plan (1981) designates the portions of the Coastal Zone along the Estero for agricultural use, with the exceptions of residential and local commercial uses within the existing Valley Ford community. The Marin County Coastal Zone also includes portions of the Estero Americano and Estero de San Antonio extending east of Highway 1; however, none of the Project facilities are located within the Coastal Zone.

Land Use Goals, Objectives, and Policies

Table 4.1-1 identifies land use goals, objectives, and policies which provide guidance for future land use patterns. The table also indicates which Land Use evaluation criteria are responsive to each set of policies.

Table 4.1-1

General Plan Goals, Objectives, and Policies - Land Use

Adopted Plan Document	Document Section	Document Numeric Reference	Policy	Relevant Evaluation Criteria[1]
Sonoma County General Plan	Land Use Element	Goal LU-5 Objective LU-5.1	Maintain Community Separators in open or natural character with low intensity of development	4,6
Sonoma County General Plan	Land Use Element	Goal LU-8 Objective LU-8.1 Objective LU-8.4 Objective LU-11.1 Objective LU-15.4 Policy LU-15h	Protect agricultural lands and avoid incompatible non-agricultural uses	1,4,5
Sonoma County General Plan	Land Use Element	Objective LU-11.5 Policy LU-11.1	Protect geothermal resources and avoid incompatible uses in the Known Geothermal Resource Area (geysers)	1,3,5
Marin Countywide Plan	Community Development Element	Policy CD-1.2	In the Inland Rural Corridor, emphasize agricultural land uses and other uses that are compatible with and enhance agricultural preservation	1
Santa Rosa General Plan	Growth Management Element; Land Use Element	Goal GM-1 Objective LUS-1c	Maintain a belt of open space around the city with agricultural and very low density uses, including Community Separators between Santa Rosa and neighboring communities	4,6,7
Santa Rosa General Plan	Land Use Element	Goal LUS-1 Objective LUS-1a	Protect and conserve open spaces and significant natural features from intrusion of degradation by inappropriate land uses	5,6,7
Rohnert Park General Plan	Land Use Element	Policy 3	Encourage the implementation of community separator policies in the County General Plan	4

Table 4.1-1

General Plan Goals, Objectives, and Policies - Land Use

Adopted Plan Document	Document Section	Document Numeric Reference	Policy	Relevant Evaluation Criteria[1]
Petaluma General Plan	Land Use Element	Policy 2 Policy 9 Policy 10	Maintain a permanent open space frame around the city to maintain its separateness and distinct character, and encourage the County to promote agricultural uses beyond the urban separator	4,6,7
Cotati General Plan	Community Identity Section	Policy 12.1.6	Establish area of community separators for preservation of open space adjacent to the city's western and southern boundaries	4,6
Windsor General Plan	Land Use Element	Policy B.4.7	Retain land beyond the proposed Sphere of Influence in County designated land use categories and oppose intensity/density increases in these areas.	1,4,6
Windsor General Plan	Land Use Element	Policy B.5 Policy B.5.2	Promote compatibility between adjacent land uses and protect residential neighborhoods from incompatible land uses	1

Source: Harland Bartholomew & Associates, Inc., 1995

Notes:
1 The Evaluation Criteria are found in Table 4.1-2.

EVALUATION CRITERIA WITH POINTS OF SIGNIFICANCE

Potential land use impacts may occur if:

- the Project results in a change in land use or
- the Project results in a loss of open space.

A change in land use is defined as a change from one land use type to another (e.g., from residential to industrial use). A loss of open space is defined as the permanent coverage of land by structures, roadways, parking areas, or other impervious surfaces.

Impacts may occur directly as a result of Project activities (e.g., conversion of land use on a site due to construction of a Project component) or indirectly within a larger geographic area over time as a result of implementing the Project (e.g., conversion of land uses within an area resulting from the land use change on the Project site.)

Table 4.1-2

Evaluation Criteria with Point of Significance - Land Use

Evaluation Criteria	As Measured by	Point of Significance	Justification
1. Will the Project be inconsistent with the land use plan map of an adopted General Plan or with an adopted Coastal Plan or Coastal Zone Management Program?	Acres of land	Greater than 0 acres of land	General Plans of Sonoma and Marin counties; cities of Cotati, Petaluma, Rohnert Park, Sebastopol and Santa Rosa; and Town of Windsor Sonoma County Local Coastal Plan and Marin County Local Coastal Program
2. Will the Project be inconsistent with zoning?	Acres of land	Greater than 0 acres of land	Zoning regulations of Sonoma and Marin counties; cities of Cotati, Petaluma, Rohnert Park, Sebastopol, and Santa Rosa; and Town of Windsor
3. Will the Project be an incompatible land use type in the MRZ-2 classification, the geysers Known Geothermal Resource Area (KGRA) or in a designated quarry area?	a. Acres of MRZ-2 land developed in incompatible uses	a. Greater than 0 acres of land	a. General Plans of Sonoma and Marin counties and the Mineral Land Classification of the Division of Mines and Geology (1989).
	b. Acres of quarry site designated by the ARM plan developed in incompatible uses	b. Greater than 0 acres of land	b. Sonoma County Aggregate Resources Management (ARM) Plan (1994).
	c. Acres of geysers KGRA developed in incompatible uses	c. Greater than 0 acres of land	c. Sonoma County Geothermal Resource Management Plan (1990).
4. Will the Project introduce inappropriate uses in a Community Separator?	Acres of land within Community Separators developed in inappropriate uses	Greater than 0 acres of land	Sonoma County General Plan

Table 4.1-2

Evaluation Criteria with Point of Significance - Land Use

Evaluation Criteria	As Measured by	Point of Significance	Justification
5. Will the Project increase potential for conflict as a result of incompatible land uses?	a. Lineal feet of incompatible uses b. Number of housing units of incompatible use	a. Greater than 0 lineal feet. b. Greater than 0 housing units.	General Plans of Sonoma and Marin counties; cities of Cotati, Petaluma, Rohnert Park, Sebastopol, and Santa Rosa; and Town of Windsor
6. Will the Project convert non-urban land to urban uses for Project facilities?	Acres of land converted	Greater than 0 acres of land	General Plans of Sonoma and Marin counties; cities of Cotati, Petaluma, Rohnert Park, Sebastopol, and Santa Rosa; and Town of Windsor
7. Will the Project convert public open space for Project facilities?	Acres of land converted	Greater than 0 acres of land	General Plans of Sonoma and Marin counties; cities of Cotati, Petaluma, Rohnert Park, Sebastopol, and Santa Rosa; and Town of Windsor

Source: Harland Bartholomew & Associates, Inc., 1995

METHODOLOGY

The adopted General Plan land use maps for the respective jurisdictions were used to determine planned land uses (other than uses in the Coastal Zone), mineral resources (other than aggregate resources), Community Separators, non-urban land, and public open space used as the basis for evaluation of impacts. Planned land uses in the Coastal Zone were determined from the adopted Coastal Plans of the respective counties. Existing land uses were determined from aerial photographs, supplemented by field observations in areas adjacent to Project facilities. Zoning regulations used as the basis of evaluation of consistency with existing zoning were obtained from the affected jurisdictions (as of June 1, 1995). Aggregate resources were defined in the Sonoma County Aggregate Resources Management Plan (1994). Geothermal resources were defined by the Sonoma County Geothermal Resources Management Plan (1990).

Environmental Consequences (Impacts) and Recommended Mitigation

No Action Alternative

Impact: **1.1.1-7. Will the No Action Alternative impact land use based on evaluation criteria 1 through 7?**

Analysis: *No Impact; Alternative 1.*

Under the No Action Alternative, there will be no land use changes resulting from new Project facilities and therefore no land use impacts as defined by the evaluation criteria. The No Action Alternative is expected to result in a building moratorium preventing general plan buildout; there will be no direct land use impacts.

Mitigation: No mitigation is needed.

Headworks Expansion Component

Impact: **1.2.1-7. Will the headworks expansion component impact land use based on evaluation criteria 1 through 7?**

Analysis: *No Impact; All Alternatives*

The expansion of the Laguna Plant's influent pumping capacity will not result in a change in land use or loss of open space, as the expanded facilities will be contained within the existing Laguna Plant site. There will be no land use impacts.

Alternative 1 does not have a headworks expansion component.

Mitigation: No mitigation is needed.

Urban Irrigation Component

Impact: **1.3.1-7. Will the urban irrigation component impact land use based on evaluation criteria 1 through 7?**

Analysis: *No Impact; All Alternatives.*

Urban irrigation will not result in a land use change or loss of open space, as the transmission pipelines are all located in public rights-of-way, and the provision of reclaimed water for irrigation will not change the existing land uses on the proposed irrigation sites, which are predominantly public and semi-public uses. There will be no land use impacts.

Alternatives 1, 4, and 5 do not have an urban irrigation component.

Mitigation: No mitigation is needed.

Pipeline Component

Impact: **1.4.1-7. Will the pipeline component impact land use based on evaluation criteria 1 through 7?**

Analysis: *No Impact; All Alternatives.*

The reclaimed water pipelines will not result in land use impacts, as there will be no change in surface land use. All of the pipelines will be contained within existing public rights-of-way, except for short segments of the main transmission lines approaching the storage reservoirs or agricultural irrigation areas. Easements will be purchased as part of the Project to accommodate these pipeline segments. The easements will not change the use of land. The pipeline alignments will be adjusted within the existing right-of-way as necessary to avoid significant trees, fences, and other structures. There will be no land use impacts.

Alternatives 1 and 5B do not have a pipeline component.

Mitigation: No mitigation is needed.

Storage Reservoir Component

Table 4.1-3

Land Use Impacts by Component - Storage Reservoirs

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
1.5.1. Will the storage reservoir component be inconsistent with the land use plan map of an adopted General Plan or with an adopted Coastal Plan or Coastal Zone Management Program?	Greater than 0 acres	None	P	==
1.5.2. Will the storage reservoir component be inconsistent with the adopted zoning?	Greater than 0 acres	None	P	==
1.5.3. Will the storage reservoir component be an incompatible land use type in the MRZ-2 classification, geysers KGRA, or in a designated quarry area?	a. Greater than 0 acres of MRZ-2 land	None	P	==

Table 4.1-3

Land Use Impacts by Component - Storage Reservoirs

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
	b. Greater than 0 acres of quarry site designated by the ARM plan			
• Adobe Road Reservoir		8 ac	P	⊙
• Two Rock Reservoir		200 ac	P	●
• All other reservoirs		None	P	==
	c. Greater than 0 acres of geysers KGRA land	None	P	==
1.5.4. Will the storage reservoir component introduce inappropriate uses in a Community Separator?	Greater than 0 acres	None	P	==
1.5.5. Will the storage reservoir component increase potential for conflict as a result of incompatible land uses?	a. Greater than 0 lineal feet	None	P	==
	b. Greater than 0 housing units	None	P	==
1.5.6. Will the storage reservoir component convert non-urban land to urban uses for Project facilities?	Greater than 0 acres	None	P	==
1.5.7. Will the storage reservoir component convert public open space for Project facilities?	Greater than 0 acres	None	P	==

Source: Harland Bartholomew & Associates, Inc. 1996

Notes: 1. Type of Impact:
P Permanent

2. Level of Significance:
● Significant impact before and after mitigation
⊙ Significant impact before mitigation; less than significant impact after mitigation
== No impact

Impact: **1.5.1, 2, 4-7. Will the storage reservoir component impact land use based on evaluation criteria 1, 2, 4, 5, 6, and 7?**

Analysis: *No Impact; All Alternatives.*

All reservoir sites are located within unincorporated Sonoma County. Storage reservoirs for agricultural irrigation are not specifically addressed in the Sonoma County General Plan or the Zoning Ordinance. However, such uses are an integral part of agricultural practices for pasture, row crops, and viticulture. In the vicinity of the reservoir sites, there are existing agricultural reservoirs and ponds located within the Land Extensive Agriculture category on the Sonoma County General Plan Land Use Maps and classified for agricultural use under existing Sonoma County zoning. While these reservoirs and ponds are considerably smaller in scale, they serve the same function as the proposed reservoirs in supplying water for agricultural use. Existing reservoirs and ponds operated as part of the Subregional System, although constructed prior to the adoption of the current Sonoma County General Plan, are also shown under the Land Extensive Agricultural category on the General Plan Land Use Maps. Based upon the function of the storage reservoirs as an integral part of agricultural production, they appear to be consistent with the Land Extensive Agriculture designations of the Sonoma County General Plan. Thus, the reservoirs could be consistent with the Land Extensive Agriculture designation of the Sonoma County General Plan.

None of the reservoir sites are located within the Sonoma County or Marin County Coastal Zone. None of the reservoir sites are within Community Separators as defined in the Sonoma County General Plan.

The change in land use on the reservoir sites from agricultural operations to facilities for the storage of reclaimed water will not result in a change of use from rural to urban. Water areas are considered to be open space under the Open Space Element of the Sonoma County General Plan.

The Bloomfield reservoir site includes portions of properties for which the Sonoma County Agricultural Preservation and Open Space District holds conservation easements. Ancillary facilities associated with the reservoir (such as roadways or pump stations) will not be located on these properties. Under the terms of the conservation easement, construction of a reservoir on this site will be allowed provided that approval is obtained from the District (Conveyance of Easement to Sonoma County Agricultural Preservation and Open Space District). Construction of the reservoir will not result in the conversion of public open space. No other reservoir site is located on or adjacent to public open space.

Alternatives 1, 4, and 5 do not have a storage reservoir component.

Mitigation: No mitigation is needed.

Impact: **1.5.3. Will the storage reservoir component be an incompatible land use type in the MRZ-2 classification, the geysers KGRA, or in a designated quarry area?**

Analysis: *Significant; Alternatives 2B and 3A.*

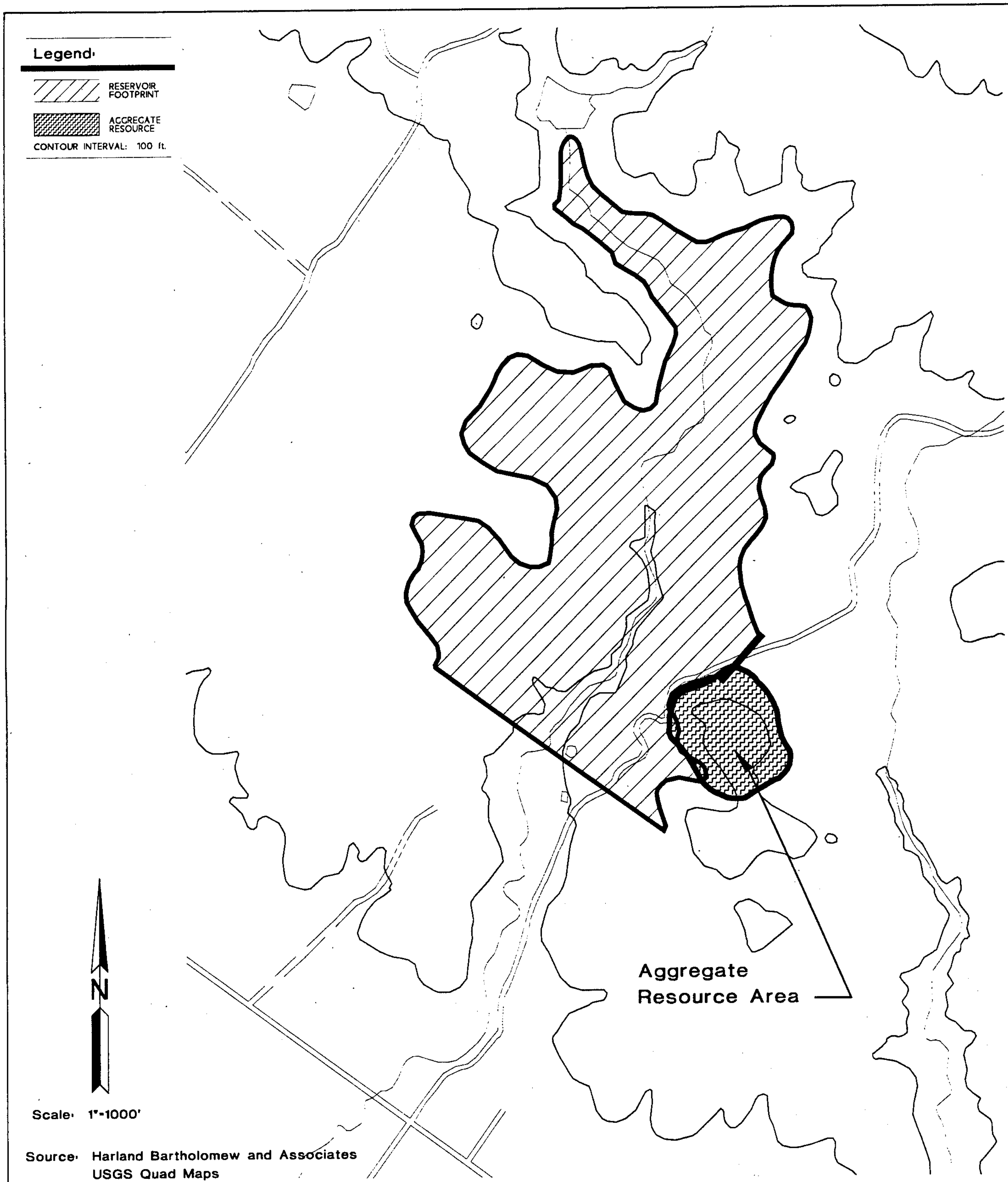
Portions of the Adobe Road (Alternative 2B) and Two Rock (Alternative 3A) sites are designated quarry sites in the Sonoma County Aggregate Resources Management (ARM) Plan (see Figures 4.1-4 and 4.1-5).

The Adobe Road site contains a permitted but yet-to-be operated borrow pit area known as the Ielmorini Quarry. This site contains an estimated 2.25 to 3.0 million tons of aggregate reserves. Expansion of the pit into the adjoining hillside as identified in the ARM Plan could produce additional reserves estimated at 3.0 to 3.5 million tons. The total area including the existing permitted operations is shown on Figure 4.1-4.

The Two Rock reservoir site contains a potential quarry site, identified as the Walker Road site in the ARM Plan. This potential quarry site contains an estimated 120 million tons of aggregate resource, of which an estimated minimum of 15 million tons is construction grade aggregate. The construction boundaries for the Two Rock site will cover approximately 30 to 40 percent of the area of aggregate resource identified in the ARM Plan.

The ARM Plan states that the designated quarry sites shall be protected from development of incompatible uses. The Plan identifies 14 to 16 existing quarry operations, along with 7 potential future sites. Loss of any one of these sites by itself will not necessarily deprive the County of the ability to provide sufficient aggregate resources in the future. However, the viability of these sites for future aggregate production is not assured for a variety of reasons, including potential encroachment of other uses, and replacement sites may not be available.

The loss of any of the identified future sites will therefore lessen the ability of the County to provide for long-term supply of aggregate material. For these reasons construction of the Adobe Road and Two Rock reservoirs, which will prevent the future development of portions of these sites for aggregate resources, is considered to be a significant impact. This is particularly important for the Two Rock site, because the estimated 15 million tons of construction grade aggregate for that site constitutes approximately 12 percent of the total future construction aggregate from the 30 quarry sources identified in the ARM Plan. Construction aggregate from these sources is a key element of the Plan, and is intended to provide a source of aggregate to replace additional river terrace mining in the County.

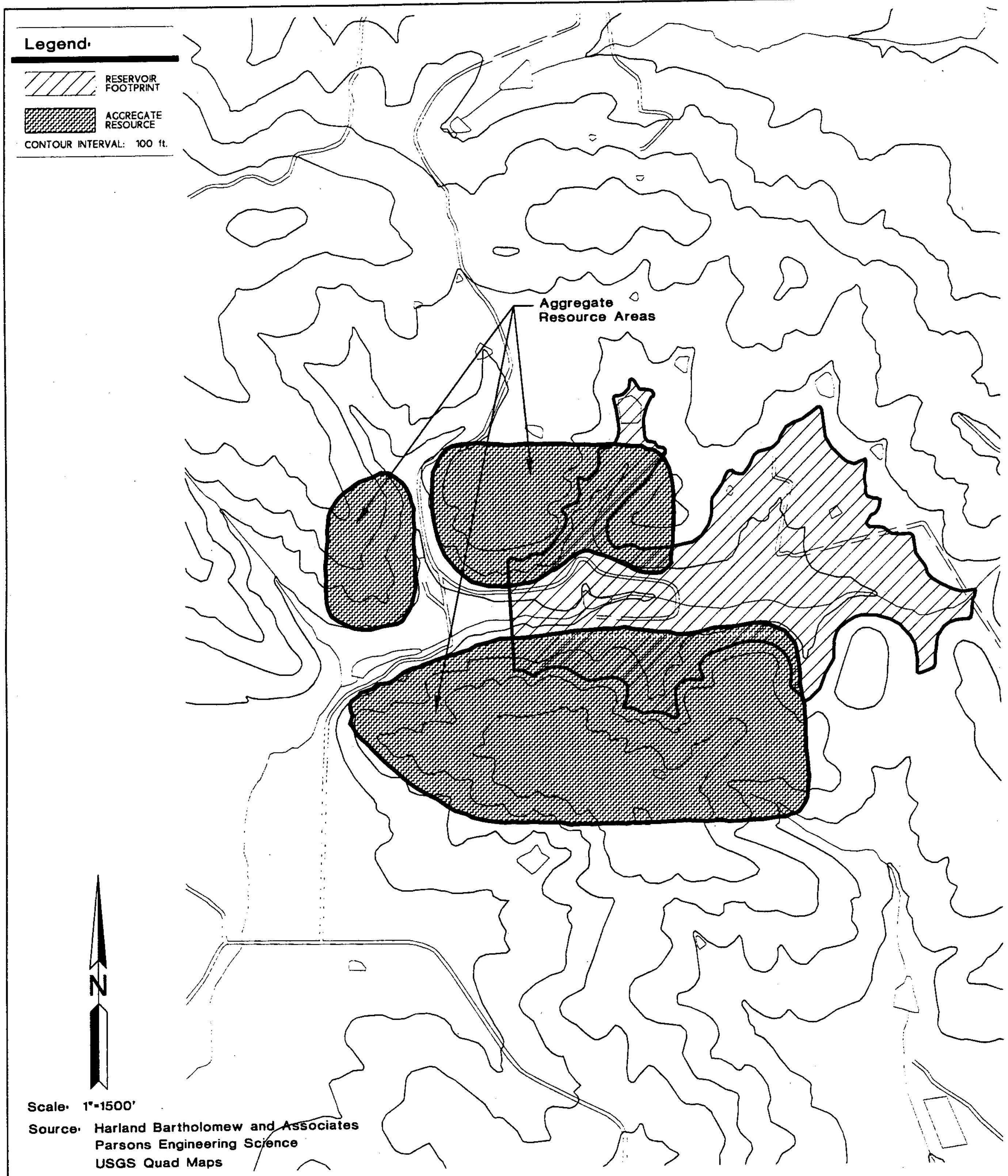


HARLAND BARTHOLOMEW and ASSOCIATES, INC.
A UNIT OF PARSONS INFRASTRUCTURE and TECHNOLOGY GROUP INC.
PARSONS

Santa Rosa
Subregional Long-Term Wastewater Project

AGGREGATE RESOURCES ADOBE ROAD RESERVOIR

Figure 4.1-4



HARLAND BARTHOLOMEW and ASSOCIATES, INC.

A UNIT OF PARSONS INFRASTRUCTURE and TECHNOLOGY GROUP INC.

PARSONS

Santa Rosa

Subregional Long-Term Wastewater Project

AGGREGATE RESOURCES TWO ROCK RESERVOIR

Figure 4.1-5

Neither the Adobe Road or Two Rock site is located in an MRZ-2 area or in the geysers KGRA. The Lakeville Hillside reservoir site (Alternative 2B) is not located on or adjacent to a designated quarry site, an MRZ-2 area or the geysers KGRA.

No Impact; Alternatives 1, 2A, 2C, 2D, 3B, 3C, 3D, 3E, 4, and 5.

None of the reservoir sites in any of the other alternatives are located on or adjacent to a designated quarry site, an MRZ-2 area, or the geysers KGRA.

Alternatives 1, 4, and 5 do not have a storage reservoir component.

Mitigation: *Alternatives 2B and 3A.*

2.4.1. Removal of Aggregate Resources Prior to Construction.

Alternatives 1, 2A, 2C, 2D, 3B, 3C, 3D, 3E, 4, and 5. No mitigation is needed.

After Mitigation: *Less than Significant. Alternative 2B.*

Mitigation Measure 2.4.1 reduces this impact to a level below significance by removal of the on-site material and by using it in the construction of the reservoir dams. Aggregate material is required for the construction of the Adobe Reservoir main dam, back dam and saddle dam, and the use of on-site material will eliminate the need for importation of aggregate material from other sites. Productive use of the entire amount of on-site material will thus replace the demand for an equivalent amount of off-site material, and preserve the off-site resources for other uses.

Significant. Alternative 3A.

Mitigation Measure 2.4.1 reduces this impact, but not to a level below significance. Construction of the Two Rock reservoir main dam will require aggregate material, which could be supplied from the on-site aggregate reserves. However, the amount of aggregate at the Two Rock site far exceeds the amount necessary for Project construction; only a fraction of the total amount will be used and the majority of the aggregate reserve will be inaccessible after construction of the reservoir. Therefore, the use of on-site aggregate resources will reduce the impact, but not to less than significant. No feasible mitigation has been identified to reduce the impact to less than significant.

Pump Station Component

Table 4.1-4

Land Use Impacts by Component - Pump Stations

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
1.6.1. Will the pump station component be inconsistent with the land use plan map of an adopted General Plan or with an adopted Coastal Plan or Coastal Zone Management Program?	Greater than 0 acres	None	P	==
1.6.2. Will the pump station component be inconsistent with the zoning?	Greater than 0 acres	None	P	==
1.6.3. Will the pump station component be an incompatible land use type in the MRZ-2 classification, geysers KGRA, or in a designated quarry area?	Greater than 0 acres	None	P	==
1.6.4. Will the pump station component introduce inappropriate uses in a Community Separator?	Greater than 0 acres	None	P	==
1.6.5. Will the pump station component increase potential for conflict as a result of incompatible land uses?	a. Greater than 0 Lineal Feet (LF)	None	P	==
	b. Greater than 0 housing units	None	P	==
1.6.6. Will the pump station component convert non-urban land to urban uses for Project facilities?	Greater than 0 acres	None	P	==
1.6.7. Will the pump station component convert public open space for Project facilities?	Greater than 0 acres			
• G-3 Geysers		1 ac	P	⊙
• All other pump stations		None	P	==

Source: Harland Bartholomew & Associates, Inc., 1995

Notes: 1. Type of Impact:
P Permanent

2. Level of Significance:
⊙ Significant impact before mitigation; less than significant impact after mitigation
== No impact

Impact: **1.6.1-6. Will the pump station component impact land use based on evaluation criteria 1, 2, 3, 4, 5, and 6?**

Analysis: *No Impact; All Alternatives.*

All pump station sites are located within compatible land use designations under the Sonoma County and Santa Rosa General Plans. Pump Station FGB, located in the Fountaingrove area, is within a Planned Development designation under the Santa Rosa General Plan. Pump Station BVB, located at the Sonoma County Fairground; Pump Station G-1, located adjacent to Delta Pond south of Guerneville Road; and Pump Stations FGS and BVS, located at the West College Ponds near Stony Point Road are within Public and Semi-Public land use designations under the Santa Rosa General Plan. Pump Stations G-3 and G-4, located on Pine Flat Road leading to the geysers recharge area, are within Resource and Rural Development land use designations under the Sonoma County General Plan. Other pump stations are located within agricultural designations under the Sonoma County General Plan.

One pump station sites (WBPS-06) is located within the Sonoma County Coastal Zone. These pump stations, as public service uses supporting agricultural irrigation, will be consistent with the designation in the Sonoma County Coastal Zone of agricultural use. No pump station sites are located within the Marin County Coastal Zone.

Pump stations located in unincorporated Sonoma County could require a conditional use permit as public service uses. These uses will not require a change in zoning district classification as public service uses are allowed in all districts.

None of the pump station sites are located on or adjacent to a designated quarry site, in an MRZ-2 area.

Pump Station G-4 is located within the geysers Known Geothermal Resources Area (KGRA) as defined in the Sonoma County Geothermal Resources Management Plan. The pump station, as a public service use supporting the production of geothermal energy will be consistent with the Land Use provisions of the Plan.

None of the pump station sites are within Community Separators as defined in the Sonoma County General Plan.

The use of land for public service facilities at the pump station sites will not be incompatible with surrounding uses. Pump stations and other similar public service facilities are considered compatible with and allowed in agricultural, residential, and commercial land use classifications under the Santa Rosa and Sonoma County General Plans and existing Santa Rosa and Sonoma County zoning. Existing facilities of

this type are located adjacent to agricultural, residential, and commercial land uses within the Project area .

The use of land for public service facilities is allowed in agricultural and other non-urban land use classifications (e.g., Rural Residential) under the Sonoma County General Plan and Sonoma County zoning. Therefore such uses will not constitute a change from open space to urban use. Comparable existing public service facilities are located within non-urban land use classifications under the Sonoma County General Plan and Sonoma County zoning.

Alternatives 1 and 5 do not have a pump station component.

Mitigation: No mitigation is needed.

Impact: 1.6.7 Will the pump station component convert public open space for Project facilities?

Analysis: *Significant; Alternative 4.*

The site for Pump Station G-3 (Alternative 4) along Pine Flat Road is located on a property for which the Sonoma County Agricultural Preservation and Open Space District holds conservation easements (see Figure 4.1-6). Construction of a pump station on this site will potentially conflict with the status of the affected property as open space under the conservation easements and will result in a loss of open space. No other pumps stations for Alternative 4 are located on or adjacent to public open space.

No Impact; Alternatives 1, 2, 3, and 5.

None of the pump station sites for these alternatives are located on or adjacent to properties which are public open space or in which the Sonoma County Agricultural Preservation and Open Space District holds any interests.

Alternatives 1 and 5 do not have a pump station component.

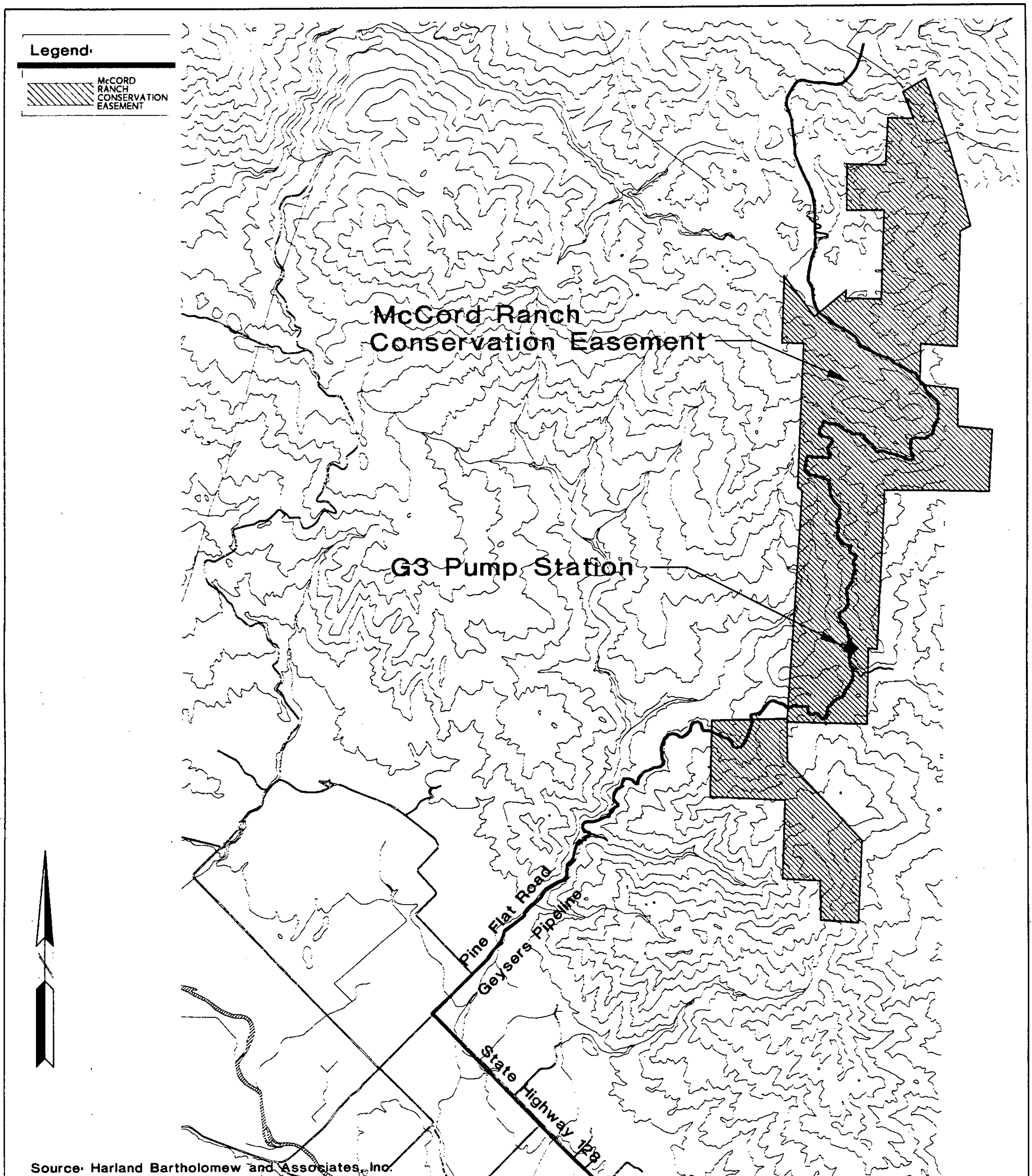
Mitigation: *Alternative 4.*

2.3.1. Replacement of Open Space Easements.

Alternatives 1, 2 , 3 and 5. No mitigation is needed.

After Mitigation: *Less than Significant after Mitigation; Alternative 4.*

Mitigation Measure 2.3.1 reduces this impact to a level below significance by providing funding to the Open Space District for the replacement on a one-for-one basis of existing acreage in open space easements. This will allow purchase of easements on new acreage in comparable areas identified by the Open Space District as a priority acquisition area.



Source: Harland Bartholomew and Associates, Inc.
USGS Quad Maps

HARLAND BARTHOLOMEW and ASSOCIATES, INC.
A UNIT OF PARSONS INFRASTRUCTURE and TECHNOLOGY GROUP INC.
PARSONS

Santa Rosa
Subregional Long-Term Wastewater Project

PINE FLAT ROAD CONSERVATION EASEMENT

Figure 4.1-6

The conveyance of funds to the District for the purchase of open space easements will ensure preservation of land as open space which is not now covered by open space easements and otherwise will not be assured of preservation as open space. Replacing existing acreage in conservation easements on a one-for one basis will mitigate the impact of Pump Station G-3 on regional open space to less than significant.

Agricultural Irrigation Component

Impact: **1.7.1-7. Will the agricultural irrigation component impact land use based on evaluation criteria 1 through 7?**

Analysis: *No Impact; All Alternatives.*

Agricultural irrigation will not result in a land use change or loss of open space, as the construction of distribution pipelines and provision of reclaimed water for irrigation will result in the continuation of agricultural use. A discussion of the impact of irrigation on the type of agricultural crops and operations is contained in Section 4.18, Socio-economics, of this document.

Alternatives 1, 4, and 5 do not have an agricultural irrigation component.

Mitigation: No mitigation is needed.

Geysers Steamfield Component

Impact: **1.8.1-7. Will the geysers steamfield component impact land use based on evaluation criteria 1 through 7?**

Analysis: *No Impact; All Alternatives.*

The recharge facilities are located within compatible land use and zoning designations (Resource and Rural Development) under the Sonoma County General Plan and Zoning Ordinance. The geysers steamfield is not located in the MRZ-2 classification, designated quarry area, or a community separator under the Sonoma County General Plan.

Conversion of existing geothermal extraction wells to injection wells and holding tanks are consistent with adjacent resource development character.

Construction of above ground distribution pipelines on presently vacant sites will result in a loss of open space, however, it will not constitute a change to urban use.

Facilities are not located on or adjacent to properties which are public open space or in which the Sonoma County Agricultural Preservation and Open Space District holds any interest.

Alternatives 1, 2, 3, and 5 do not have a geysers steamfield component.

Mitigation: No mitigation is needed.

Discharge Component

Impact: **1.9.1-7. Will the discharge component impact land use as based on evaluation criteria 1 through 7?**

Analysis: *No Impact; All Alternatives.*

Use of the existing facilities for discharge of reclaimed water to the Laguna de Santa Rosa will not result in a land use change. A new outfall on the Russian River is located within a compatible land use designation (Resource and Rural Development) under the Sonoma County General Plan and is allowed under the Zoning District. The outfall could require a conditional use permit as a public service use.

The outfall is compatible with the adjacent agricultural and resource development uses; and is not located in an MRZ-2 area, a quarry site designated in the Sonoma County ARM Plan, the geysers KGRA, or a Community Separator as defined in the Sonoma County General Plan. Construction of above ground facilities associated with a new Russian River discharge will not change the non-urban character of the area, and the site is not located on or adjacent to public open space. Discharge of additional reclaimed water as part of the Contingency Plan will not result in a land use change or a loss of open space.

Mitigation: No mitigation is needed.

CUMULATIVE IMPACTS

There are two impacts -- either less than significant or significant -- identified in the Land Use section:

Impact: **1.3C. Will the Project plus cumulative projects be an incompatible land use type in a Mineral Resource Zone(MRZ), geysers KGRA or in a quarry area? Two Rock and Adobe Road storage reservoirs.**

Analysis: A review of the general plans in the cumulative project study area and the cumulative projects list indicates three potentially cumulative projects. The Cloverdale General Plan Conservation and Open Space Element has a policy to discourage expansion of sand and gravel operations within their study area. Similarly, the Healdsburg General Plan indicates plans to develop some of their MRZ land. The Novato General Plan identifies one parcel which is designated for development on MRZ land. Impacts of the Long-Term Project at both Two Rock and Adobe Road have been found to be significant, and although there are other projects in the region which will increase the cumulative impact, such projects will not warrant a change in either the finding of significance or the mitigation proposed.

Alternatives 1, 2A, 2C, 2D, 3B, 3C, 3D, 3E, 4 and 5 do not have any incompatible land uses in a MRZ, geysers KGRA, or in a quarry.

Impact: **1.7C. Will the Project plus cumulative projects convert public open space for project facilities? Geysers pump station.**

Analysis: A review of the general plans for jurisdictions near the geysers and the cumulative projects list indicates no similar projects in the geysers area.

Alternatives 1, 2, 3, and 5 will not convert public open space for project facilities.

SUMMARY OF SIGNIFICANT IMPACTS AND MITIGATION MEASURES

Table 4.1-5

Summary of Significant Impacts and Mitigation Measures - Land Use

Impact	Level of Significance	Mitigation Measure
Storage Reservoir Component		
1.5.3. The storage reservoir component may be an incompatible land use type in a designated quarry area.	Alt 2B - ⊙ Alt 3A - ●	2.4.1. Removal of aggregate resources prior to construction.
Pump Station Component		
1.6.7. The storage reservoir component may convert public open space for Project facilities.	Alt 4 - ⊙	2.3.1. Replacement of open space easements.

Source: Harland Bartholomew and Associates, Inc., 1996

Notes:

● Significant impact before and after mitigation

⊙ Significant impact before mitigation; less than significant impact after mitigation

SUMMARY OF IMPACTS BY ALTERNATIVE

Table 4.1-6

Summary of Impacts by Alternative - Land Use

Component	Alt 1	Alt 2A	Alt 2B	Alt 2C	Alt 2D	Alt 3A	Alt 3B	Alt 3C	Alt 3D	Alt 3E	Alt 4	Alt 5A	Alt 5B
No Action (No Project) Alternative	==	--	--	--	--	--	--	--	--	--	--	--	--
Headworks Expansion	--	==	==	==	==	==	==	==	==	==	==	==	==
Urban Irrigation	--	==	==	==	==	==	==	==	==	==	--	--	--
Pipelines	--	==	==	==	==	==	==	==	==	==	==	==	--
Storage Reservoirs	--	==	⊙	==	==	●	==	==	==	==	--	--	--
Pump Stations	--	==	==	==	==	==	==	==	==	==	⊙	--	--
Agricultural Irrigation	--	==	==	==	==	==	==	==	==	==	--	--	--
Geysers Steamfield	--	--	--	--	--	--	--	--	--	--	==	--	--
Discharge	--	==	==	==	==	==	==	==	==	==	==	==	==

Source: Harland Bartholomew & Associates, Inc., 1996

Notes: Level of Significance

-- Not applicable
== No impact
● Significant impact before and after mitigation
⊙ Significant impact; less than significant after mitigation

PREPARERS, REFERENCES, AND COORDINATION AND CONSULTATION

Preparers

Robert Duchek, Harland Bartholomew & Associates, Inc.

Reviewers

Malcolm Drummond, Harland Bartholomew & Associates, Inc.
Nannie Turrell, Parsons Engineering Science, Inc.
Anders J. Hauge, Harland Bartholomew & Associates, Inc.
Patricia I. Collins, Harland Bartholomew & Associates, Inc.
Robin P. Cort, Ph.D., Parsons Engineering Science, Inc.
John Cummings, Ph.D., Peer Review Committee
David Ziegler, Peer Review Committee

References

HBA Team Documents

None

Other References

City of Cotati. 1989. *City of Cotati General Plan.*

City of Rohnert Park. 1990. *General Plan of the City Of Rohnert Park, California.* April 10.

City of Rohnert Park. 1994. *Second Draft, General Plan of the City of Rohnert Park.* June 30.

Marin County Planning Department. 1994. *Community Development Element, Marin Countywide Plan.* April.

City of Petaluma. 1993. *Petaluma General Plan, 1987-2005.* March.

City of Sebastopol. 1994. *Sebastopol General Plan.* May 31.

City of Santa Rosa, Department of Community Development. 1993. *Zoning Code 1993.* June 15. Revisions through March 22, 1995.

City of Santa Rosa Department of Community Development. 1991. *Santa Rosa 2010 General Plan.* July. With amendments to November 1994.

County of Marin. 1980. *Marin County Local Coastal Program.* April.

County of Sonoma. 1994. *Sonoma County Aggregate Resources Management Plan and Environmental Impact Report.* November.

County of Sonoma. 1993. *Zoning Ordinance.*

County of Sonoma. 1990. *Sonoma County Geothermal Resources Management Plan.*

County of Sonoma. 1989. *Sonoma County General Plan.* March 23. Revisions to April 9, 1991.

County of Sonoma. 1981. *Sonoma County Coastal Plan.* January.

County of Sonoma. *Agricultural Preservation and Open Space District, Conveyance of Easement.*

Mineral Land Classification Division of Mines and Geology. 1989. *RC Special Report #146, Part III and Surface Mining and Reclamation Act Designation Report No. 7.*

State of California, Public Resources Code, Division 20. 1976. *California Coastal Act 1976.* Revised January 1980.

Town of Windsor. 1996. *Town of Windsor General Plan.*

Consultation and Coordination

Persons Contacted

Steven Scholl, California Coastal Commission
James R. Raives, California Coastal Commission
Dennis Dorch, City of Cotati
Kurt Yeiter, City of Petaluma
Paul Skanchy, City of Rohnert Park
Dan Carlson, City of Santa Rosa
Marie Meredith, City of Santa Rosa
Richard Spitler, City of Sebastopol
Robert Gaiser, County of Sonoma
Melanie Heckel, County of Sonoma
Richard Holmes, County of Sonoma
Kenneth Milam, County of Sonoma
Richard Rodgers, County of Sonoma
Dino Bonos, Sonoma County Agricultural Preservation and Open Space District
David Woltering, Town of Windsor

Correspondence

Letter to Patricia Collins, HBA from Richard Rodgers, County of Sonoma. February 26, 1996. Regarding Sonoma County General Plan policies relevant to Santa Rosa Long-Term Wastewater Project.

TABLE OF CONTENTS

LIST OF TABLES

4.2 AGRICULTURE

This section discusses loss of important agricultural lands, disqualification of lands under Williamson Act contracts, reduction of agricultural soil productivity due to erosion, and the build-up of trace elements or salinity in agricultural soils. To provide a context for these analyses, the setting section provides information on classification of farmlands, data on existing agriculture in the project area, and a summary of policies regarding agricultural resources, including Williamson Act contracts and local general plan policies. Irrigation in the Sebastopol area could be part of either a West County or South County alternative, and is included in the evaluations of both alternatives.

IMPACTS EVALUATED IN OTHER SECTIONS

The following items are related to the Agriculture Section but are evaluated in other sections of this document.

- Soil Erosion. Erosion from construction activities is discussed in Section 4.3, Geology, Soils, and Seismicity. Sedimentation in waterways is evaluated in Section 4.6, Surface Water Quality. On-site erosion from agricultural practices is evaluated in this section on Agriculture.
- Increased Agricultural Productivity. Provision of reclaimed water for agricultural irrigation would provide economic value to agriculture by allowing production of higher value agricultural products. The potential impact on the local agricultural economy from the availability of reclaimed water is discussed in Section 4.18, Socio-economics.
- Water Quality Impacts of Bay Flats Irrigation. Water quality concerns associated with irrigation of the Bay Flats are addressed in Section 4.5, Groundwater Section and in 4.6, Surface Water Quality.

AFFECTED ENVIRONMENT (SETTING)

As noted in the Land Use Section (4.1), vast areas of Sonoma and Marin counties are farm or grazing lands. That section discusses generalized locations of crop and grazing areas.

Important Farmland Series Maps

The California Department of Conservation has modified the U.S. Department of Agriculture Soil Conservation Service maps to show farmland and urban areas in California. These *Important Farmland Series Maps for Sonoma County* classify the farmlands of the state as (California Department of Land Conservation, Office of Land Conservation, Farmland Mapping & Monitoring Program 1992):

- Prime Farmland. This category of land has the best combination of physical and chemical characteristics for the production of crops. It has the soil quality, growing season, and moisture supply needed to produce sustained high yields of crops when treated and managed, including water management, according to current farming methods. Prime Farmland must have been used for the production of irrigated crops at some time during the two update cycles prior to the mapping date. Maps are updated every two years.

- Farmland of Statewide Importance. Although similar to Prime Farmland, this category of land has minor shortcomings, such as greater slopes or less ability to hold and store moisture. This land must have been used for the production of irrigated crops at some time during the two update cycles prior to the mapping date.

- Unique Farmland. This land has lesser quality soils and is used for the production of specific high economic value crops at some time during the two update cycles prior to the mapping date. It has the special combination of soil quality, location, growing season, and moisture supply needed to produce sustained high quality or high yields of a specific crop when treated and managed according to current farming methods. Unique farmland is usually irrigated, but may include non-irrigated orchards or vineyards as found in some climatic zones. Examples of crops on unique farmland include oranges, olives, avocados, rice, grapes, and cut flowers.

- Farmland of Local Importance. This land is of importance to the local agricultural economy, determined by each county's board of supervisors and local advisory committees. Examples could include dairies, dryland farming, aquaculture and uncultivated areas with soils qualifying for Prime Farmland and Farmland of Statewide Importance. Farmland of Local Importance does not include publicly owned lands for which there is an adopted policy preventing agricultural use.

Throughout this section these categories of farmlands: Prime Farmland, Farmland of Statewide Importance, Unique Farmland, and Farmland of Local Importance, are referred to collectively as status farmlands.

Williamson Act Lands

Another classification of agricultural lands of concern is Williamson Act contract lands as defined in the California Land Conservation Act of 1965. The law was enacted to protect agriculture and open space land and to adjust imbalanced tax practices. Williamson Act contracts also known as agricultural preserves, offer tax incentives for agricultural land preservation by ensuring that land will be assessed for its agricultural productivity rather than its highest and best uses.

In order to cancel a Williamson Act contract, a landowner must file a notice of nonrenewal. Beginning at the next contract anniversary date, the contract winds down over its remaining (usually nine-year) term. During this time the taxes on the contract

lands gradually return to their pre-contract levels. After nonrenewal has been filed, a landowner may petition to the city/county in which jurisdiction the land is located for early cancellation of the contract. The council/board of that jurisdiction may grant tentative approval for cancellation only if it makes one of the following findings:

- That the cancellation is consistent with the purposes of the Williamson Act; or
- That cancellation is in the public interest (Government Code Section 51282(a).

In order to find that cancellation is consistent with the purposes of the Williamson Act, the council/board must find the following:

- That a notice of nonrenewal has been filed.
- That cancellation would not likely result in the removal of adjacent lands from agricultural use.
- That cancellation would result in an alternative use which is consistent with provisions of the applicable General Plan.
- That discontiguous patterns of urban development would not result from cancellation.
- That there is no proximate noncontracted land which is both available and suitable for the proposed use, or that development of contracted land would provide more contiguous patterns of urban development.

In order to find that cancellation is in the public interest, the council/board must find:

- That public concerns substantially outweigh Williamson Act objectives;
- That there is no proximate noncontracted land which is both available and suitable for the proposed use, or that development of contracted land would provide more contiguous patterns of urban development.

Senate Bill 1534 (approved by the Governor and filed with the Secretary of State in 1994) amended Williamson Act provisions pertaining to acquisition of contracted land for public improvements. Article 6 of the Williamson Act (Government Code Sections 51290-51295) provides that a public entity may acquire land within an agricultural preserve for a public improvement through eminent domain or in lieu of eminent domain, and that this action terminates the contract. Specific provisions contained in Senate Bill 1534 define procedures which the agency must follow in notifying the Director of the Department of Conservation, conditions under which a public improvement may not be located within a preserve, and public improvements which are exempt from these conditions. These provisions are summarized below:

Notification Provisions. At the time a public agency is considering locating a public improvement within an agricultural preserve, notice must be sent to the Director of the Department of Conservation and the local governing body responsible for administration of the contract. The notification must include the total number of Williamson Act acres to be acquired and whether or not they include Prime Farmland; the purpose of the acquisition and why the parcel was selected; the location; characteristics of adjacent land; location maps; copies of the contract; and explanation of findings (see explanation below).

Findings. A public agency shall not locate a public improvement within an agricultural preserve unless the following findings are made:

- The location is not based primarily on a consideration of the lower cost of acquiring land in an agricultural preserve; and
- If the land is Prime Farmland covered under a contract pursuant to Article 6 for any public improvement, that there is no other land within or outside the preserve on which it is reasonably feasible to locate the public improvement.

Agricultural Crop Summary

Table 4.2-1 presents approximate bearing acreage and cash value of the most important crops in Sonoma County for 1994. The table indicates the dominance of the wine industry; however, little viticulture occurs in the potentially affected West and South County areas. The sections of Marin County that could be affected by the proposed project are mostly grazing areas.

Table 4.2-1

Sonoma County Agricultural Summary

Crop	Acreage	Cash Value
Grapes	33,800	$ 152,280,700
Apples	5,250	8,131,500
Other Fruits and Nuts	1,250	9,312,000
Vegetables	1,000	15,491,500
Livestock and Poultry	NA	37,519,200
Livestock and Poultry Products (including milk)	NA	84,937,500
Silage	258,000	10,600,200

Source: Office of Agricultural Commissioner Sonoma County, Agricultural Crop Report, Sonoma County 1994

Currently, most of the West and South County study areas are not intensively cultivated. Farmed acreage is predominantly hay and grazing pasture for cattle and dairy operations. Intensive agricultural development is constrained by the lack of a developed, dependable, and inexpensive water supply.

Agriculture Goals, Objectives, and Policies

Table 4.2-2 identifies goals, objectives, and policies which provide guidance for future agricultural resources. The table also indicates which criteria in the Agriculture Section are responsive to each set of policies. Because there are no Project facilities in the General Plan areas of Cotati, Rohnert Park or Sebastopol (except for a segment of pipeline in Sebastopol), agricultural policies of these cities are not discussed.

Table 4.2-2

General Plan Goals, Objectives, and Policies - Agriculture

Adopted Plan Document	Document Section	Document Numeric Reference	Policy	Relevant Evaluation Criteria[1]
Sonoma County General Plan	Agricultural Resources Element	Goal AR-3 Objective AR-3.2 Policy AR-3a	Maintain agricultural land in parcel sizes that are suitable for agricultural purposes	2
Sonoma County General Plan	Agricultural Resources Element	Objective AR-8.1 Policy AR-8c	Continue Participation in the Williamson Act	2
Sonoma County General Plan	Agricultural Resources Element	Objective AR-8.2 Policy AR-8f	Encourage participation in programs for reuse of treated wastewater which are beneficial for agriculture	1,3,4
Marin Countywide Plan	Agriculture Element	Policy A-1.1 Policy A-1.3	Maintain agricultural land in parcel sizes that are suitable for agricultural purposes	2
Marin Countywide Plan	Agriculture Element	Program A-1.3a	Continue Participation in the Williamson Act	2
Santa Rosa General Plan	Open Space and Conservation Element	Goal OSC-8 Objective OSC-8a	Support conservation and preservation of prime agricultural land and commercial agriculture outside the Urban Boundary	1,2,3,4

Table 4.2-2

General Plan Goals, Objectives, and Policies - Agriculture

Adopted Plan Document	Document Section	Document Numeric Reference	Policy	Relevant Evaluation Criteria[1]
Petaluma General Plan	Open Space, Conservation and Energy Element	Goal 4 Objective (g) Policy 14	Preserve and protect agricultural use on land surrounding the city and reduce pressure for urbanization of agricultural land	1,2,3,4

Source: Harland Bartholomew and Associates, Inc., 1996

1. Evaluation criteria are identified in Table 4.2-3.

EVALUATION CRITERIA WITH POINT OF SIGNIFICANCE

CEQA Appendix G states that a project will have a significant impact on the environment if it will, "Convert prime agricultural land to non-agricultural use or impair the agricultural productivity of prime agricultural land."

Potential agricultural impacts may occur if the Project were to result in:

- Loss of farmland with a status defined by the State Department of Conservation; or
- Reduced productivity of the soil, caused by soil erosion or chemical toxicity.

The criteria of significance for loss of farmland and reduced soil productivity are presented in Table 4.2-3.

Reduction of Soil Productivity

Two potential causes of reduced soil productivity have been evaluated, erosion and trace element loading (chemical toxicity), and therefore two sets of evaluation criteria have been developed. Using the U.S. Department of Agriculture's soil erosion prediction model, the Universal Soil Loss Equation (USLE), soil types have been rated according to their soil loss tolerance, or "T" value. The T value expressed as annual tons per acre of allowable soil loss. The annual soil loss due to the Project exceeds the T Value for that soil, erosion impacts are considered significant.

The *Trace Element Loading Analysis for the South and West County Reclamation Alternatives* (Questa Engineering Corporation 1995c) presents 32 constituents analyzed for in reclaimed water from the Laguna Plant and compares them with EPA and California standards. References are:

- EPA. 1993. *Standards for the Use or Disposal of Sewage Sludge* (Title 40 of the Code of Federal Regulations [CFR], Part 503), published in the Federal Register (58 FR 9248 to 9404) on February 19.
- Pettygrove Asano. 1984. *Irrigation with Reclaimed Municipal Wastewater, A Guidance Manual* (Chapter 12, Nitrogen and Phosphate; and Chapter 13, Metals).

Table 4.2-3

Evaluation Criteria with Point of Significance - Agriculture

Evaluation Criteria	As Measured by	Point of Significance	Justification
1. Will the Project cause loss of farmland?	Acres of status[1] farmland lost	Greater than 0 acres	CEQA and State of California Department of Conservation
2. Will the Project cause Williamson Act contracts to be canceled?	Number of remainder parcels under Williamson Act contract which are less than 10 acres of status[1] farmland or 40 acres of non-status farmland due to purchase of land for the Project.	Greater than 0 remainder parcels smaller than contract criteria	California Land Conservation Act of 1965
3. Will the Project reduce agricultural soil productivity due to erosion of topsoil?	Annual tons per acre (T values)	Universal Soil Loss Equation-predicted annual soil loss exceeds the T value	USDA Universal Soil Loss Equation
4. Will the Project reduce agricultural soil productivity due to build-up of trace elements or salinity?	a. Suitability of reclaimed water for irrigation (pH units, mg/l, or mmhos/cm)	Exceedence of FAO Guidelines	United Nations Food and Agricultural Organization (FAO) Irrigation Water Guidelines
	b. Metals loading (kilograms/hectare) in soils from application of reclaimed water and fertilizer/manure	Exceedence of state guidelines or federal rules	State Water Resources Control Board Report #84-1 (Pettygrove G.S. and Asano, T. 1996); EPA 503 Rules for applications of sludge

Source: Parsons Engineering Science, Inc. 1996

Notes:
1. For the purposes of this document, status farmland includes the following categories defined by the California Department of Conservation: Prime Farmland, Farmland of Statewide Importance, Unique Farmland, and Farmland of Local Importance.

METHODOLOGY

This impact analysis is based on a review of relevant literature and technical reports prepared for the impact evaluation for this project. Overlays of farmland categories (mapped at a scale of 1:24,000) supplied by the Department of Conservation, Office of Land Conservation, Farmland Mapping and Monitoring Program were used to evaluate acres of Prime Farmland impacted by the construction of reservoirs and pump stations. The technical reports listed in the References section provide additional details on methodology.

The *Evaluation of Soil Erosion Impacts of the West and South County Reclamation Alternatives* (Questa Engineering Corporation 1996) evaluates the impacts of changes in agricultural land use and practices which may be caused by the availability of reclaimed water. Soil erosion due to the Project was estimated using the U.S. Department of Agriculture's soil erosion prediction model, the Universal Soil Loss Equation (USLE) and compared to the T value of that soil. The T value is the soil loss tolerance as developed by the USDA Natural Resources Conservation Service.

The *Trace Element Loading Analysis for the South and West County Reclamation Alternatives* (Questa Engineering Corporation 1995c) presents 12 constituents analyzed in Santa Rosa reclaimed water comparing them with EPA and California standards.

Build-up of trace elements was calculated based on average levels of these constituents in existing reclaimed water. Analysis of impacts was based on the assumption that the Irrigation Management Plan Guidelines set forth in Chapter 2 (Measures 2.2.1 through 2.2.5) would be implemented. These measures are included in the Project description and establish performance criteria for agricultural irrigation. The provisions of those guidelines are summarized below.

Irrigation Management Measures

Measures 2.2.1 through 2.2.7 identify procedures and practices that have been adopted as part of the Project by the City. These measures provide the basis for the Irrigation Conservation and Management Program and establish the irrigation system planning, and the design principles and guidelines, that are required for incorporating individual farms and ranches into expansion of the agricultural irrigation system. These measures implement the Irrigation Management Guidelines. Each parcel brought into the reclamation program would be subject to a site-specific Irrigation Conservation and Management Program (ICMP). The requirements of the individual ICMP are described in more detail in Section 2.2.

ENVIRONMENTAL CONSEQUENCES (IMPACTS) AND MITIGATION MEASURES

No Action Alternative

Impact: **2.1.1-4. Will the No Action Alternative impact agriculture based on evaluation criteria 1 through 4?**

Analysis: *No Impact; Alternative 1.*

The No Action Alternative will not cause the loss of any agricultural land or reduce agricultural soil productivity.

Mitigation: No mitigation is needed.

Headworks Expansion Component

Impact: **2.2.1-4. Will the headworks expansion component impact agriculture based on evaluation criteria 1 through 4?**

Analysis: *No Impact; All Alternatives.*

Expansion of the Laguna Plant headworks will take place entirely within an existing building and will, therefore, not cause the loss of any agricultural land or reduce agricultural soil productivity.

Alternative 1 does not have headworks expansion component.

Mitigation: No mitigation is needed.

Urban Irrigation Component

Impact: **2.3.1-4. Will the urban irrigation component impact agriculture based on evaluation criteria 1 through 4?**

Analysis: *No Impact; All Alternatives.*

Urban irrigation is applied to urban properties only, such as golf courses, landscaping, and school grounds. This component, therefore, will not cause the loss of any agricultural land or reduce agricultural soil productivity.

Alternatives 1, 4, and 5 do not have a urban irrigation component.

Mitigation: No mitigation is needed.

Pipeline Component

Impact : **2.4.1. Will the pipeline component cause loss of farmland?**

Analysis: *No Impact; All Alternatives.*

Pipelines follow public rights-of-way or private roads. However, for the Tolay, Sears Point, Huntley, Two Rock, and Bloomfield reservoirs it will be necessary to disrupt agricultural land to construct the pipeline connections to storage reservoirs. This will be a temporary disruption, and will result in no loss of farmland. Measure 2.2.9, Retain Stripped Topsoil, incorporated into the Project, requires that, following construction, the soil layers over the pipelines will be replaced as they were before pipeline installation occurred. The amount of land temporarily disrupted will be less than one acre. There will be no permanent loss of prime agricultural soils.

Alternatives 1 and 5B do not have a pipeline component.

Mitigation: No additional mitigation is needed.

Impact: 2.4.2-4. Will the pipeline component impact agriculture based on evaluation criteria 2, 3 and 4?

Analysis: *No Impact; All Alternatives.*

Because there is no permanent loss of agricultural soils, Williamson Act contracts will not be affected.

Operation of pipelines will not affect agricultural soil production. Measure 2.2.9, Retain Stripped Topsoil, is incorporated into the Project Description and would serve to maintain agricultural productivity of the soil for areas affected by pipeline construction.

Pipelines will not introduce any trace element into the soil.

Rupture of pipelines could erode agricultural soil, but will do so infrequently and in a localized manner so that it will not be a problem for long-term agricultural production.

Alternatives 1 and 5B do not have a pipelines component.

Mitigation: No mitigation is needed.

Storage Reservoir Component

Table 4.2-5

Agricultural Impacts by Component - Storage Reservoirs

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
2.5.1. Will the storage reservoir component cause loss of farmland?	Greater than 0 acres of status[3] farmland removed			
• Tolay Extended		456	P	●
• Adobe Road		28	P	●
• Tolay Confined		108	P	●
• Two Rock		114	P	●
• All other reservoirs		0	P	==
2.5.2. Will the storage reservoir component cause Williamson Act contracts to be canceled?	Greater than 0 remainder parcels smaller than contract criteria			
• Bloomfield		1	P	●
• Huntley		1	P	●
• All other reservoirs		0	P	==
2.5.3. Will the storage reservoir component reduce agricultural soil productivity due to erosion of topsoil?	USLE predicted annual soil loss exceeds the T value	None	O&M	==
2.5.4. Will the storage reservoir component reduce agricultural soil productivity due to build-up of trace elements?	a. Exceedence of FAO Guidelines.	None	O&M	==
	b. Exceedence of state guidelines or federal rules	None	O&M	==

Source: Parsons Engineering Science, Inc., 1996

Notes: 1. Type of Impact:
O&M Operation and Maintenance
P Permanent

2. Level of Significance:
● Significant impact before and after mitigation
○ Less than significant impact; no mitigation proposed
== No impact

3. Status Farmland is Prime Farmland, Unique Farmland, Farmland of Statewide Importance, or Farmland of Local Importance as defined by the California Department of Conservation.

Impact: 2.5.1. Will the storage reservoir component cause loss of farmland?

Analysis: *Significant; Alternatives 2A, 2B, 2C, 3A.*

The Tolay Extended, Adobe Road, Tolay Confined, and Two Rock reservoirs will cause the loss of substantial amounts of agricultural land. Table 4.2-6 summarizes status farmland impacts by reservoir location.

No Impact; Alternatives 2D, 3B, 3C, 3D, 3E, 4, and 5.

Although the Lakeville Hillside, Sears Point, Bloomfield, Carroll Road, Valley Ford, and Huntley reservoirs would displace grazing land, none will cause the loss of Prime Farmland, Farmland of Statewide or Local Importance, or Unique Farmland.

Table 4.2-6

Loss of Farmland by Reservoir[1]
(acres)

Reservoir	Grazing Land	Unique Farmland	Farmland of Local Importance	Total Construction Impact Area
Tolay Extended	158	418	38	1,065
Adobe Road	147	0	28	350
Tolay Confined	76	108	0	605
Lakeville Hillside	152	0	0	230
Sears Point	274	0	0	465
Two Rock	115	0	114	350
Bloomfield	195	0	0	340
Carroll Road	241	0	0	315
Valley Ford	230	0	0	375
Huntley	184	0	0	305

Source: California Department of Land Conservation, Office of Land Conservation, Farmland Mapping and Monitoring Program, 1992. Parsons Engineering Science, Inc. 1996

Notes:
[1]No Prime Farmland or Farmland of Statewide Importance would be impacted by reservoirs.

One of the long-term consequences of implementing alternatives with storage reservoirs will be to enhance the viability of agricultural production in the counties of Sonoma and Marin. As the Socio-economic Section states, the reclamation alternatives will have a positive net economic return due to a projected increase in agricultural production

value, made possible by the creation of a reliable source of irrigation water. By making water available, the reclamation alternatives could increase production of existing operations and convert to commodities which provide higher economic returns. However, the loss of agricultural land remains an adverse impact. Project facilities will remove status farmland from use. In some cases, entire farms will be eliminated.

Alternatives 1, 4, and 5 do not have a storage reservoir component.

Mitigation: *Alternatives 2A, 2B, 2C, and 3A.* No feasible mitigation has been identified.

Alternatives 1, 2D, 3B, 3C, 3D, 3E, 4, and 5. No mitigation is needed.

After Mitigation: *Significant; Alternatives 2A, 2B, 2C, and 3A.*

Impact: 2.5.2. Will the storage reservoir component cause Williamson Act contracts to be canceled?

Analysis: *Significant; Alternatives 3B and 3E.*

Purchase of Williamson Act Contract Land for a storage reservoir will leave a remainder parcel of less than 40 acres at both the Bloomfield and Huntley reservoir sites. Depending on ownership patterns, this may disqualify these parcels from Williamson Act statutes.

No Impact; Alternatives 1, 2, 3A, 3C, 3D, 4 and, 5.

The Tolay Extended, Adobe Road, Tolay Confined, Lakeville Hillside, Sears Point, Two Rock, Carroll Road, and Valley Ford reservoirs sites will result in the purchase of portions of parcels under Williamson Act contract, requiring cancellation of the contract on those lands. However, the remaining parcels will be large enough to allow continuation of the contract. Table 4.2-7 shows the amount of land which will be removed from Williamson Act, parcel by parcel, as a result of construction of each proposed reservoir.

The Sears Point reservoir site has no Williamson Act contract land; however, it is part of Alternative 2D with the Lakeville Hillside reservoir.

Table 4.2-7

Loss of Williamson Act Contract Land by Reservoir

Reservoir	Parcel Number	Parcel Size (acres)	Reservoir Size within Parcel (acres)	Total Area Remaining in Williamson Act (acres)
Tolay Extended	68-050-23	303	55	248
	68-060-55	118	46	72
	68-080-03	607	5	602
	68-080-02	325	6	319
Adobe Road	136-14-03	160	9	151
Tolay Confined	68-08-03	607	15	592
	68-080-02	325	18	307
Lakeville Hillside	68-110-17	174	55	119
	68-110-29	201	27	174
	68-110-33	91	18	73
	68-110-34	128	55	73
Sears Point	No Williamson Act contract lands.	---	---	---
Two Rock	22-020-01	404	37	367
Bloomfield	27-020-06	319	83	236
	27-030-03	162	126	36
	27-030-02	277	19	258
	27-040-11	216	16	200
	27-020-02	200	4	196
	27-010-12	106	14	92
	73-020-04	458	7	451
Carroll Road	73-020-04	458	99	359
	73-020-07	487	165	322
Valley Ford	26-070-12	186	28	158
	26-070-08	549	178	371
	26-080-05	600	80	520
Huntley	27-230-07	101	46	55
	27-230-08	92	18	74
	27-230-10	174	4	170
	27-230-04	202	73	129
	27-230-06	92	55	37

Source: Parsons Engineering Science, Inc., 1996,
Harland Bartholomew & Associates, Inc. 1996

In order to find that the cancellation is consistent with the purposes of the Williamson Act, the Sonoma County Board of Supervisors must find that the conditions set forth in the setting section are met. A preliminary analysis of these conditions is provided below. The County Board of Supervisors will make Findings to grant or deny approval for cancellation based on their own evaluation.

- A notice of nonrenewal has been filed.

  It is assumed that a notice of nonrenewal will be filed at the time the land is purchased.

- That adjacent lands will not likely be removed from agricultural use.

  By providing a reliable source of water for agriculture, the Project would likely help to maintain agricultural use on adjacent parcels.

- That cancellation is for an alternative use consistent with the Sonoma County General Plan.

- *The Sonoma County General Plan is not specific regarding consistency of large storage reservoirs within an agricultural land use designation. Because the reservoirs are for the purpose of supporting increased agricultural production, this document concludes that the storage reservoirs are consistent with the County General Plan. The County has not made a determination of consistency.*

- That cancellation will not result in discontiguous patterns of urban development.

  Cancellation is not for the purpose of unplanned urban development. Development of a reservoir to store nonpotable reclaimed water is expected to enhance the long-term prospects of agriculture in the area, and, therefore, reinforce agricultural land uses.

- That there is no nearby, noncontracted land, available and suitable for the proposed use.

  The reservoir sites which are being analyzed were chosen for their topographic properties, size, hydraulic suitability, proximity to the treatment plant, existing reclaimed water distribution system, and proposed reuse areas. Selection of these sites was made after an extensive process. Because of the requirements necessary for a reservoir site and the selection process used, it is unlikely that noncontracted land that will meet the storage reservoir engineering criteria is available in the vicinity of the selected sites.

The following are conditions for locating public improvements in an agricultural preserve:

- The location is not based primarily on a consideration of the lower cost of acquiring land in an agricultural preserve.

  The location is not based on cost of agricultural land, but is controlled by the need to locate reservoir sites near agricultural irrigation areas, and by the requirement for suitable topography.

- If the land is Prime Farmland covered under a contract pursuant to Article 6 for any public improvement, that there is no other land within or outside the preserve on which it is reasonably feasible to locate the public improvement.

None of the reservoir sites contains Prime Farmland.

This preliminary evaluation indicates that cancellation of Williamson Act contract status is possible and indeed consistent with Williamson Act intentions.

Alternatives 1, 4, and 5 do not have a storage reservoir component.

Mitigation: *Alternatives 3B and 3E.* No feasible mitigation has been identified.

Alternatives 1, 2, 3A, 3C, 3E, 4 and 5. No mitigation is proposed.

After Mitigation: *Significant; Alternatives 3B and 3E.*

Impact: 2.5.3-4. Will the storage reservoir component impact agriculture based on evaluation criteria 3 and 4?

Analysis: *No Impact; All Alternatives.*

Storage reservoirs will not cause erosion of agricultural soils beyond the footprint of the reservoir. Therefore, there is no impact.

Storage reservoirs will not cause build-up of trace elements or salt in the surrounding agricultural soils. Therefore, there is no impact.

Alternatives 1, 4, and 5 do not have a storage reservoir component.

Mitigation: No mitigation is needed.

Pump Station Component

Table 4.2-8

Agricultural Impacts by Component - Pump Stations

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
2.7.1. Will the pump station component cause loss of farmland?	Greater than 0 acres of status[3] farmland removed.			
• Tolay Extended		0.2	P	●
• Adobe Road/Lakeville		0.2	P	●
• Tolay Confined		0.2	P	●

Table 4.2-8

Agricultural Impacts by Component - Pump Stations

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
• Lakeville/Sears Point		0.3	P	●
• Two Rock		0.2	P	●
• Bloomfield		0.2	P	●
• Carroll Road		0.2	P	●
• Valley Ford		0.2	P	●
• Huntley		0.2	P	●
• Geysers Recharge		0.1	P	●
• Discharge		--	P	--
2.7.2. Will the pump station component cause Williamson Act contracts to be canceled?	Greater than 0 parcels	None	P	==
2.7.3. Will the pump station component reduce agricultural soil productivity due to erosion of topsoil?	USLE-predicted annual soil loss exceeds the T value	None	O&M	==
2.7.4. Will the pump station component reduce agricultural soil productivity due to build-up of trace elements?	a. Exceedence of FAO Guidelines	None	O&M	==
	b. Exceedence of state guidelines or federal rules	None	O&M	==

Source: Parsons Engineering Science, Inc., 1996

Notes: 1. Type of Impact:
O&M Operation and Maintenance
P Permanent

2. Level of Significance:
● Significant impact before and after mitigation
-- Not applicable
== No impact

3. Status Farmland is Prime Farmland, Unique Farmland, Farmland of Statewide Importance, or Farmland of Local Importance as defined by the California Department of Conservation.

Impact: 2.6.1. Will the pump station component cause loss of farmland?

Analysis: *Significant; Alternatives 2, 3, and 4.*

Booster pump stations will be constructed on farm and grazing lands. Impacts from Pump Stations at reservoir sites are addressed under Impact 2.5.1. For each of the South and West County alternatives, at least one

Booster pump station will be constructed on either Prime, Unique, or Locally Important Farmland. This removal of status farmland from agricultural use for the lifetime of the pump stations will be a significant impact. The largest area lost to pump station construction will be about 0.3 acres (13,500 sq. ft.) required for building the pump stations associated with the Lakeville/Sears Point Alternative. Table 4.2-9 summarizes pump station dislocation of Prime, Unique or Locally Significant Farmland.

No Impact; Alternatives 1 and 5.

These alternatives do not have a pump station component.

Mitigation: *Alternatives 2, 3, and 4.* No feasible mitigation has been identified.

Alternatives 1 and 5. No mitigation is needed.

After Mitigation: *Significant; Alternatives 2, 3, and 4.*

Avoidance is not possible because of other factors involved in selecting pump station sites. Replacement cannot be achieved with status agricultural land which has the same Farmland Mapping Program category because the replacement land will already be in agricultural use.

Table 4.2-9

Status Farmland Required for Pump Stations

Alternative	Pump Station	Size (square feet)	Status of Farmland
Tolay Extended	SBPS-3	800	Local
	SBPS-8	1,500	Local
	SBPS-10	2,700	Local
	LBPS-1	800	Prime
	LBPS-2	2,700	Unique
		Total: 8,500	
Adobe Road/Lakeville	SBPS-3	800	Local
	SBPS-8	1,500	Local
	SBPS-10	2,700	Local
	SBPS-11	1,500	Local
	LBPS-1	800	Prime
	LBPS-2	2,700	Unique
		Total: 10,000	

Table 4.2-9

Status Farmland Required for Pump Stations

Alternative	Pump Station	Size (square feet)	Status of Farmland
Tolay Confined	SBPS-3	800	Local
	SBPS-8	1,500	Local
	SBPS-10	2,700	Local
	LBPS-1	800	Prime
	LBPS-2	2,700	Unique
		Total: 8,500	
Lakeville/Sears Point	SBPS-3	800	Local
	SBPS-7	2,700	Local
	SBPS-8	1,500	Local
	SBPS-9	800	Local
	SBPS-10	2,700	Local
	SBPS-11	1,500	Local
	LBPS-1	800	Prime
	LBPS-2	2,700	Unique
		Total: 13,500	
Two Rock	WBPS-1	800	Local
	WBPS-3	800	Local
	WBPS-4	1,500	Local
	WBPS-5	2,700	Local
	LBPS-1	800	Prime
	LBPS-2	2,700	Unique
		Total: 9,300	
Bloomfield	WBPS-1	800	Local
	WBPS-3	800	Local
	WBPS-4	1,500	Local
	WBPS-5	2,700	Local
	LBPS-1	800	Prime
	LBPS-2	2,700	Unique
		Total: 9,300	
Carroll Road	WBPS-1	800	Local
	WBPS-3	800	Local
	WBPS-4	1,500	Local
	WBPS-5	2,700	Local
	LBPS-1	800	Prime
	LBPS-2	2,700	Unique
		Total: 9,300	

Table 4.2-9

Status Farmland Required for Pump Stations

Alternative	Pump Station	Size (square feet)	Status of Farmland
Valley Ford	WBPS-1	800	Local
	WBPS-3	800	Local
	WBPS-4	1,500	Local
	WBPS-5	2,700	Local
	LBPS-1	800	Prime
	LBPS-2	2,700	Unique
		Total: 9,300	
Huntley	WBPS-3	800	Local
	WBPS-4	1,500	Local
	WBPS-5	2,700	Local
	LBPS-1	800	Prime
	LBPS-2	2,700	Unique
		Total: 8,500	
Geysers Recharge	GSP2-2	43,560	Prime

Source : Parsons Engineering Science, Inc., 1996, and California Department of Land Conservation, Office of Land Conservation, Farmland and Monitoring Mapping Program, 1992

Impact: **2.6.2-4. Will the pump station component impact agriculture based on evaluation criteria 2, 3 and 4?**

Analysis: *No Impact; All Alternatives.*

Pump stations delivering water to agricultural areas will occupy from 800 to 2,700 square feet of land adjacent to roads. They will not interfere with the ability of a parcel to meet the requirements of the Williamson Act.

Pump stations will have no impacts on surrounding soils.

Pump stations will not cause build-up of trace elements or salt in the surrounding agricultural soils.

Alternatives 1 and 5 do not have a pump station component.

Mitigation: No mitigation is needed.

Agricultural Irrigation Component

Table 4.2-10

Agricultural Impacts by Component - Agricultural Irrigation

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
2.7.1. Will the agricultural irrigation component cause loss of farmland?	Greater than 0 acres of status farmland removed	None	P	+
2.7.2. Will the agricultural irrigation component cause Williamson Act contracts to be canceled?	Greater than 0 parcels	None	P	==
2.7.3. Will the agricultural irrigation component reduce agricultural soil productivity due to erosion of topsoil?	USLE-predicted annual soil loss exceeds the T value	Soil loss greater than T value for orchards and vineyards on slope greater than 10%; specialty crops on slopes greater than 5%	O&M O&M-CP	⊙ ⊙
2.7.4. Will the agricultural irrigation component reduce agricultural soil productivity due to build-up of trace elements?	a. Exceedence of FAO Guidelines	No exceedences	O&M	❍
	b. Exceedence of state guidelines or federal rules	No exceedences	O&M	❍

Source: Parsons Engineering Science, Inc., 1996

Notes:

1. Type of Impact:

O&M Operation and Maintenance
O&M-CP Operation and Maintenance - Contingency Plan
P Permanent

2. Level of Significance:

== No impact
\+ Beneficial impact
❍ Less than significant impact; no mitigation proposed
⊙ Significant impact before mitigation; less than significant impact after mitigation

3. Status Farmland is Prime Farmland, Unique Farmland, Farmland of Statewide Importance, or Farmland of Local Importance as defined by the California Department of Conservation.

Impact: **2.7.1. Will the agricultural irrigation component cause loss of farmland?**

Analysis: *Beneficial Impact; Alternatives 2 and 3.*

Availability of proposed irrigation water could cause new land to be brought into agricultural production, and will cause existing agricultural land to become irrigated, thus raising its value under the categories of the State Farmlands Mapping Program. The gain in acres of land qualifying as Prime Farmland or Farmland of Statewide Importance cannot be estimated, because it is currently unknown which landowners may contract with the City for reclaimed water. However, Farmland of Local Importance includes areas of dairies and other dryland farming that have soils qualifying as Prime Farmland or Farmland of Statewide Importance; availability of irrigation water will raise some of these areas to the higher status category. A lack of water currently prevents these areas from being used at their highest agricultural potential.

No Impact; Alternatives 1, 4, and 5.

These alternatives do not have an agricultural irrigation component.

Mitigation: No mitigation is needed.

Impact: **2.7.2. Will the agricultural irrigation component cause Williamson Act contracts to be canceled?**

Analysis: *No Impact; All Alternatives.*

Irrigation of Williamson Act lands is not cause for contract cancellation.

Alternatives 1, 4 and 5 do not have an agricultural irrigation component.

Mitigation: No mitigation is needed.

Impact: **2.7.3. Will the agricultural irrigation component reduce agricultural soil productivity due to erosion of topsoil?**

Analysis: *Significant; Alternatives 2 and 3.*

With implementation of the following measures adopted as part of the Project, on-site erosion within agricultural areas will be reduced:

2.2.1. Irrigation Conservation and Management Program.

2.2.2. Irrigation Site Resource Maps.

2.2.3. Restrict Surface and Subsurface Irrigation Water Runoff.

2.2.4. Restrict Sediment Movement (Irrigation Sites).

2.2.5. Avoid Sensitive Biological Resources (Irrigation Areas).

Using these measures, erosion will be less than existing for most types of agriculture. However, even with these management practices, soil erosion

is found to exceed the T value (see Methodology portion of this section) in the following circumstances:

- New orchards and vineyards on slopes greater than 10 percent; and
- Specialty crops on slopes greater than 5 percent.

Although it is expected that erosion in the West County will be greater, erosion for these two categories would be significant in both South and West County.

Erosion problems associated with changes in grazing practices cannot be directly evaluated using the same methodology. Irrigation of pasture lands may cause an increase in the number of animals per acre. However, with implementation of the project design measures listed above, the potential for erosion will not increased.

Winter irrigation, if required, will be subject to similar constraints and will have impacts similar to dry-season irrigation.

No Impact; Alternatives 1, 4, and 5

Alternatives 1, 4 and 5 do not have an agricultural irrigation component.

Mitigation: *Alternatives 2 and 3.*

2.3.2. Restrict Approval of Agricultural Irrigation Contracts.

2.3.3. Agricultural Irrigation Demonstration Program.

Alternatives 1, 4 and 5. No mitigation is needed.

After Mitigation: *Less than Significant; Alternatives 2 and 3.*

These measures will prohibit irrigation contracts for new orchards and vineyards with slopes greater than 10 percent and for specialty crops on slopes greater than percent unless the demonstration program described below can develop methods for erosion control that will not cause T values to be exceeded.

If the T value is not exceeded, then contracts for irrigation on similar slopes with similar crops may be signed. Monitoring of these contracts shall include erosion measurements for the first two seasons; contracts are subject to cancellation if erosion cannot be reduced below the T value.

Impact: 2.7.4. Will the agricultural irrigation component reduce agricultural soil productivity due to build-up of trace elements or salts?

Analysis: *Less than Significant; Alternatives 2 and 3.*

A. Suitability of Reclaimed Water for Irrigation.

Trace elements are metals that are needed by plants in low concentrations. Higher concentrations may prove detrimental. The trace element loading analysis was completed using long-term average reclaimed water data and annual average irrigation application rates of 2.0 acre-feet per acre for the West County and 2.9 acre-feet per acre for South County. (Application rates will be slightly different for Sebastopol, at about 1.7 acre-feet per year, and for the Bay Flats, at about 3 acre-feet per year.) The analysis is conservative in that it includes no loss of metals by leaching. As indicated in Table 4.2-11, the reclaimed water is of high quality and no significant direct toxicity or other effects are anticipated.

As indicated in Table 4.2-11, the salt content of the reclaimed water (as measured by Total Dissolved Solids and Salinity) is within the guidelines for agricultural irrigation. Further study of the possible build-up of salts in relation to leaching requirements was conducted and no potential problems were identified (Questa Engineering Corporation 1995d).

Table 4.2-11

Suitability of Reclaimed Water for Agricultural Irrigation

Constituent	Reclaimed Water Quality (mg/l unless noted)	FAO Irrigation Water Guidelines[1] (mg/l unless noted)
pH	7.0-7.4 pH	6.5-8.4 pH
Total Dissolved Solids	450	450-1000
Salinity	0.78 mmhos/cm	0.5-0.8 mmhos/cm
Sodium Absorption Ratio (adj)	2.8	<6.0
Sodium	80	70-80
Chloride	120	140-200
Boron	0.48	<1.5
Ammonium nitrogen	4.1	5-30
Nitrate nitrogen	16.3	5-30
Arsenic	0.002	0.1
Cadmium	0.001	0.01
Chromium	0.002	0.1
Copper	0.01	0.2
Lead	0.005	5.0
Nickel	0.004	0.2
Selenium	0.005	0.05
Zinc	0.03	3.0

Source: Parsons Engineering Science, Inc., 1996

Notes:
1. United Nations Food and Agricultural Organization Irrigation Water Guidelines

B. Metals Loading in Soils from Application of Reclaimed Water and Fertilizer/Manure.

A trace element loading analysis was completed for select metals. Reclaimed water chemistry data and average irrigation application rates used were the same as those used for the previous analysis of irrigation suitability. The analysis is conservative in that it assumes no loss of metals by leaching, although in reality approximately 2 to 20 percent of the applied metals may leave the site in leachate.

Although the reclaimed water contains some small fertilizer values (principally nitrogen), the irrigation water will not be likely to meet total plant nutrition needs for all elements, particularly phosphorus. Therefore, application of supplemental fertilizers is likely. Fertilizers will contribute small quantities of metals to the soil, including impurities associated with commercial chemical fertilizers used for vegetables and specialty crops and animal manure used on forage and pasture lands. In Table 4.2-12, the projected metals loadings are presented as a range, representing reclaimed water only and reclaimed water plus chemical fertilizer or manure. As indicated in the Table, accumulation of metals in soil is very low and will not affect productivity or toxicity after 25 years or even 500 years of use.

Accumulation will be lower for crops than for grazing because trace elements are absorbed by crops, reducing soil concentrations. No reduction through this mechanism has been assumed, because trace elements will remain in any areas that are used for grazing. The overall conclusion that impacts will be less than significant is supported by ongoing monitoring of the existing reclamation system, which has shown no measurable accumulation of salts or metals in soils (personal communication, Don Fox, CH2M Hill, February 1, 1996).

Table 4.2-12

Metals Loading Due to Irrigation with Reclaimed Water and Fertilizer or Manure

Constituent	Loading after 25 Years[1] (kg/hectare)		State[4] Guidelines (kg/hectare)	EPA Rules[5] (kg/hectare)	Least Number of Years until State Guidelines or EPA Rules Exceeded	
	South County[2]	West County[3]			South County[2]	West County[3]
Arsenic	0.68	0.46	--	41	1,500	2,200
Boron	106	73	--	--	--	--
Cadmium	0.45-0.62	0.31-0.47	20	39	800	1,100
Chromium	0.88-0.93	0.61-0.67	--	3,000	80,400	112,400
Copper	2.9-3.0	2.0-2.1	500	1,500	4,200	6,000

Table 4.2-12

Metals Loading Due to Irrigation with Reclaimed Water and Fertilizer or Manure

Constituent	Loading after 25 Years[1] (kg/hectare)		State[4] Guidelines (kg/hectare)	EPA Rules[5] (kg/hectare)	Least Number of Years until State Guidelines or EPA Rules Exceeded	
Lead	2.0-2.3	1.4-1.7	2,000	300	3,200	4,400
Molybdenum	8.5	6.0	--	--	--	--
Nickel	1.5-2.1	1.1-1.6	500	420	5,100	6,700
Selenium	0.43	0.31	--	100	5,900	8,200
Zinc	7.2	5.0-5.1	1,000	2,800	3,500	1,400
Silver	0.44	0.31	--	--	--	--
Mercury	0.63	0.15	--	17	700	2,800

Source: Trace Element Loading Analysis for the West County and South County Alternatives. Questa Engineering Corporation 1995c.

Note:
1. The lower value in the range is the effect of reclaimed water without fertilizer; the higher value is the effect of reclaimed water plus fertilizer or manure, whichever contributes more. Chemical fertilizer contributes more metals for all constituents except zinc; manure contributes more zinc than fertilizer.
2. The Bay flats area will be irrigated at about 3.5% higher application rate than the rest of South County, so loading after 25 years will be about 3.5% higher, and it will take about 3.5% fewer years to exceed specified levels.
3. Sebastopol will be irrigated at about a 10% lower application rate than West County, so loading after 25 years will be about 10% lower, and it will take about 10% more years to exceed specified levels.
4. State Water Resources Control Board Report #84-1.
5. EPA 503 Rules for Application of Sludge.

Effects on Livestock. These analyses show that levels of trace elements in the soils are so low that no effects on crops or livestock will be expected. The National Research Council's 1996 publication on *Use of Reclaimed Water and Sludge in Food Crop Production* provides additional information regarding effects on crops and livestock, which is summarized below (National Research Council 1996).

Previous studies have shown that irrigation with reclaimed water does not result in elevated levels of trace elements in crops. For many elements (e.g., chromium, mercury, and lead) there is a "soil-plant barrier" that prevents movement of elements into edible plant parts. Elements such as copper and zinc are more mobile within plants, but are toxic to plants at much lower levels than those which will affect animals. These two mechanisms prevent adverse effects to livestock, even in situations where levels of trace elements are elevated in soils. Livestock can, however, be harmed by excessive levels of selenium, molybdenum, or cadmium in crops. Most studies of these elements have focused on sludge application, because levels of trace elements are higher in sludge than in reclaimed

water. Levels of selenium in reclaimed water are exceptionally low, and no cases of molybdenum toxicity to animals have been reported as resulting from consumption of feed from sludge-amended soils. Cadmium has been shown to accumulate in liver and kidneys of animals fed crops grown on sludge-amended soils. However, no adverse effects were observed, and milk from goats fed silage grown on sludge-amended soils did not have elevated levels of cadmium. The National Research Council concludes that there is no evidence for adverse effects to livestock due to trace elements in feed from sludge-amended soils. (National Research Council 1996)

No Impact; Alternatives 1, 4 and 5.

These Alternatives do not have an agricultural irrigation component.

Mitigation: No mitigation is proposed.

Geysers Steamfield Component

Impact: **2.8.1-4. Will the geysers steamfield component impact agriculture based on evaluation criteria 1 through 4?**

Analysis: *No Impact; All Alternatives.*

The geysers steamfield component does not occur on agricultural soils and will not affect prime farmland, Williamson Act contracts, or agricultural production.

Alternatives 1, 2, 3, and 5 do not have a geyser steamfield component.

Mitigation: No mitigation is needed.

Discharge Component

Impact: **2.9.1-4. Will the discharge component impact agriculture based on evaluation criteria 1 through 4?**

Analysis: *No Impact; All Alternatives.*

The discharge facilities will not cause the loss of any agricultural land or reduce agricultural soil productivity. Discharge of reclaimed water into the Laguna or directly into the Russian River will not impact agricultural productivity.

Mitigation: No mitigation is needed.

CUMULATIVE IMPACTS

There are four impacts -- either less than significant or significant -- identified in the Agriculture section:

Impact: **2.1C. Will the Project plus cumulative projects cause a loss of farmland?**

Analysis: In Sonoma County between 1990 and 1992, status farmland decreased by 2,239 acres of grazing land, by 5,522 acres of Farmland of Local Importance, and increased by 231 acres of Unique Farmland. Impacts of the Long-Term Project on status farmland have been designated as significant and unavoidable even though impacts are less than one acre for all alternatives except the Tolay, Adobe Road, and Two Rock reservoirs. Cumulative impacts exacerbate the significance of this loss of farmland, however, cumulative impacts would not warrant a change in either the finding of significance either before or after mitigation.

Despite the impacts described above, Alternatives 2 and 3 would have an overall cumulative benefit to agriculture. Provision of reclaimed water, and implementation of long-term contracts with agricultural users would enhance productivity of existing agricultural lands, provide substantial economic benefits (see Socio-economics Section), and would tend to maintain lands in agricultural use that might otherwise be converted to other uses. The availability of reclaimed water may be a major factor in reducing loss of agricultural land in Sonoma County.

Impact: **2.2C. Will the Project plus cumulative projects cause Williamson Act contracts to be canceled?**

Analysis: Refer to cumulative impacts described in the preceding impact.

Impact: **2.3C. Will the Project plus cumulative projects reduce agricultural soil productivity due to erosion of topsoil?**

Analysis: Reduction of soil productivity due to erosion of topsoil is a long-term, existing problem in the study area. In recent years, there has been a trend to cultivate steeper slopes, especially for vineyards, causing accelerated erosion. In addition, proposed expansion of irrigation with reclaimed water from other sewage treatment plants includes: 2,075 acres from Petaluma, 745 acres from Windsor, 400 acres from the Russian River County Sanitary District, and a couple of hundred acres from Forestville, Camp Meeker, Geyserville, Graton, Occidental, and the Sonoma County Airport.

Long-Term Project impacts on soil productivity are identified as significant for orchards and vineyards on slopes greater than 10 percent and for specialty crops on slopes greater than 5 percent. However, for most other lands proposed for irrigation, the Long-Term Project would actually reduce erosion rates due to required management techniques listed in Chapter 2.2. Therefore, impacts from cumulative projects would not be

significant, except for the sloping lands where impacts have already been identified as significant. No change in mitigation is warranted.

Impact: **2.4C. Will the Project plus cumulative projects reduce agricultural soil productivity due to build-up of trace elements?**

Analysis: This impact occurs on a very localized basis. Even though there are other agricultural lands proposed for irrigation as identified in the previous impact discussion, there would be no interaction or overlapping of impacts such that the standard used as the point of significance would be exceeded.

SUMMARY OF SIGNIFICANT IMPACTS AND MITIGATION MEASURES

Table 4.2-13

Summary of Significant Impacts and Mitigation Measures - Agriculture

Impact	Level of Significance	Mitigation Measure
Storage Reservoir Component		
2.5.1. The storage reservoir component may cause loss of farmland.	Alt2A - ● Alt 2B - ● Alt 2C - ● Alt 3A - ●	No feasible mitigation has been identified.
2.5.2. The storage reservoir component may cause Williamson Act contracts to be canceled.	Alt 3B - ● Alt 3E - ●	No feasible mitigation has been identified.
Pump Station Component		
2.6.1. The pump station component may cause loss of farmland.	Alt 2 - ● Alt 3 - ● Alt 4 - ●	No feasible mitigation has been identified.
Agricultural Irrigation Component		
2.7.3. The agricultural irrigation component may reduce agricultural soil productivity due to erosion of topsoil.	Alt 2 - ⊙ Alt 3 - ⊙	2.3.2 Restrict Approval of Agricultural Irrigation Contracts. 2.3.3. Agricultural Irrigation Demonstration Program.

Source: Parsons Engineering Science, Inc., 1996

Although the Summary Tables, 4.2-13 and 4.2-14, show significant impacts associated with loss of farmland and cancellation of Williamson Act contracts, Alternatives 2 and 3 will have a substantial benefit to agriculture, and will increase the classification status of

some agriculture land. For example, some Farmland of Local Importance would be converted to Prime Farmland with the provision of irrigation water. Because specific acreage cannot be calculated until contracts with individual users are established, it is not possible to determine which status farmland might experience a net increase, but there are benefits to agriculture that offset loss of agriculture lands at reservoir sites and pump stations.

SUMMARY OF IMPACTS BY ALTERNATIVE

Table 4.2-14

Summary of Impacts by Alternative -Agriculture

Component	Alt 1	Alt 2A	Alt 2B	Alt 2C	Alt 2D	Alt 3A	Alt 3B	Alt 3C	Alt 3D	Alt 3E	Alt 4	Alt 5A	Alt 5B
No Action (No Project) Alternative	==	--	--	--	--	--	--	--	--	--	--	--	--
Headworks Expansion	--	==	==	==	==	==	==	==	==	==	==	==	==
Urban Irrigation	--	==	==	==	==	==	==	==	==	==	--	--	--
Pipelines	--	==	==	==	==	==	==	==	==	==	==	==	--
Storage Reservoirs	--	●	●	●	==	●	●	==	==	●	--	--	--
Pump Stations	--	●	●	●	●	●	●	●	●	●	●	--	--
Agricultural Irrigation	--	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	--	--	--
Geysers Steamfield	--	--	--	--	--	--	--	--	--	--	==	--	--
Discharge	--	==	==	==	==	==	==	==	==	==	==	==	==

Source: Parsons Engineering Science, Inc., 1996

Notes: Level of Significance Codes

- -- Not applicable
- ● Significant impact before and after mitigation
- == No impact
- ⊙ Significant impact; less than significant after mitigation

Preparers, References, and Consultation and Coordination

Preparers

Li Boccia, Parsons Engineering Science, Inc.
Nannie Turrell, Parsons Engineering Science, Inc.

Reviewers

Patricia I. Collins, Harland Bartholomew & Associates, Inc.
Robin P. Cort, Ph.D., Parsons Engineering Science, Inc.
John Cummings, Ph.D., Peer Review Committee
Bob Duchek, Harland Bartholomew & Associates, Inc.
Mark Grismer, Ph.D., Peer Review Committee
Anders Hauge, Harland Bartholomew & Associates, Inc.
Jeff Peters, Questa Engineering Corporation, Inc.
Dave Ziegler, Peer Review Committee

References

HBA Team Documents

Questa Engineering Corporation, Inc. 1995a. *Irrigation Management Guidelines for the West County and South County Alternatives.* July. (Appendix D-19).

Questa Engineering Corporation, Inc. 1995b. *Cropping Scenarios for the West County and South County Reclamation Alternatives.* September 19. (Appendix E-3).

Questa Engineering Corporation, Inc. 1995c. *Trace Element Loading Analysis for the West County and South County Reclamation Alternatives.* September 19. (Appendix E-6).

Questa Engineering Corporation, Inc. 1995d. *Irrigation Water Quality and Salt Management Leaching Requirements, South County and West County Reclamation Alternatives.* December 18. (Appendix E-5).

Questa Engineering Corporation, Inc. 1996. Evaluation of Soil Erosion Impacts of the West and South County Reclamation Alternatives. February 1. (Appendix E-7).

Other References

California Department of Land Conservation, Office of Land Conservation, Farmland Mapping and Monitoring Program. 1984. *Advisory Guidelines for the Farmland Mapping and Monitoring Program.*

California Department of Land Conservation, Office of Land Conservation, Farmland Mapping and Monitoring Program. 1992. *Important Farmland Series Maps for Sonoma County.*

California Department of Conservation, Office of Land Conservation. 1995a. *Cancellation Process for Williamson Act Contracts.*

California Department of Conservation, Office of Land Conservation. 1995b. *The Williamson Act: Protecting Our Land Resources.*

California Department of Conservation, Office of Land Conservation. 1995c. *Notification Provisions of the Williamson Act.*

California Department of Land Conservation, Office of Land Conservation, Farmland Mapping and Monitoring Program. 1988. *Sonoma County Farmland Conversion Report 1984 to 1986.*

California Department of Land Conservation, Office of Land Conservation, Farmland Mapping and Monitoring Program. 1994. *Sonoma County Farmland Conversion Report 1990 to 1992.*

Environmental Protection Agency (EPA). 1993. *Standards for the Use or Disposal of Sewage Sludge* (Title 40 of the Code of Federal Regulations [CFR], Part 503), Federal Register (58 FR 9248 to 9404). February 19.

Government Code - Article 6, Sections 51290-51295.

National Research Council. 1996. *Use of Reclaimed Water and Sludge in Food Crop Production.* National Academy Press.

Office of Agricultural Commissioner Sonoma County. 1995. *Agricultural Crop Report Sonoma County 1994.*

Pettygrove G.S. and Asano, T. 1985. *Irrigation with Reclaimed Municipal Wastewater - A Guidance Manual,* (Chapter 12, Nitrogen and Phosphate and Chapter 13, Metals). Lewis Publishers, Inc. Chelsea, Michigan (originally published as State Water Resources Control Board Publication #84-1).

Renard, K.G., G.R. Foster, G.A. Weesies, D.K. McCool, and D.C. Yoder. 1994. *Predicting Soil Erosion by Water: A Guide to Conservation Planning with the Revised Universal Soil Loss Equation (RUSLE)* USDA-ARS. 1994.

Consultation and Coordination

Persons Contacted

Gail Davis, Sonoma County Permit and Resource Management Environmental and Comprehensive Planning Division, March 1996.

Patricia Gatz, Associate Analyst, Williamson Act Program, Department of Conservation, March 31, 1994, December 4, 1995.

Richard Rodgers, Planner III, Sonoma County Permit and Resource Management, December, 1995.

Correspondence

Don Fox, CH2M Hill, February 1, 1996.

Jeffery Peters. Questa Engineering Corporation, Inc. 1995f. *Summary of South and West County Existing Agricultural Use*. Facsimile to Nannie Turrell at Parsons Engineering Science, Inc. from Jeffrey Peters. August 17.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

4.3 GEOLOGY, SOILS, AND SEISMICITY

This section provides information regarding hazards for Project facilities in relation to unstable slopes, surface traces of active faults, areas susceptible to liquefaction, and areas with potential for earthquake-induced groundshaking. The potential for injection of reclaimed water at the geysers to induce seismicity is evaluated. To provide a basis for this evaluation, the setting section provides information on regional geology, including a description of major geologic units and locations of faults. The general geologic conditions at each reservoir site and within the geysers area are presented. Mechanisms of geologic instability are discussed, with particular reference to Project facilities. Soil types are characterized, including an evaluation of hazards such as expansiveness, corrosivity, and erosion potential. Regulations intended to minimize geologic hazards are summarized, including requirements for building and grading permits, erosion control, and dam design.

IMPACTS EVALUATED IN OTHER SECTIONS

The following items are related to the Geology, Soils, and Seismicity section but are evaluated in other sections of this document.

- Topographic Alterations. Construction of dams, reservoirs, and the geysers pipeline would involve substantial excavation and filling and would permanently alter topography. Potential impacts that would result from topographic alterations are discussed in Section 4.14, Visual Resources.
- Mineral Resources. Construction of a dam and reservoir at the Two Rock and Adobe Road sites could affect aggregate reserves in the vicinity. Potential impacts to mineral resources are discussed in Section 4.1, Land Use.
- Flooding Due to Dam Failure. Potential impacts from dam failure and inundation are discussed in Section 4.19, Inundation from Dam Failure.
- Soil Erosion. Soil erosion related to agricultural irrigation is discussed in Section 4.2, Agriculture. Sedimentation of waterways is discussed in Section 4.6, Surface Water Quality.
- Groundwater. Potential environmental impacts that could affect the quantity and quality of groundwater are addressed in Section 4.5, Groundwater.
- Streambank Erosion. Erosion within streams and rivers due to changes in flows is discussed in Section 4.4, Surface Water Hydrology.

AFFECTED ENVIRONMENT (SETTING)

Geology

The Project area, which includes most of Sonoma County and adjacent northern Marin County, is immediately east of the San Andreas Fault zone (Figure 4.3-1). The northwest-trending San Andreas Fault zone is the junction between two crustal plates: the North American plate, which forms the land mass to the east, and the Pacific plate, which is mostly under water in the vicinity of the Project area. The movement between these two plates, over many millions of years, has produced the northwest-trending ridges and valleys present in Sonoma County and throughout the Coast Ranges. The plate boundary is defined by many nearly parallel faults, which, together with the San Andreas Fault, are the main sources of seismic activity in the vicinity of the Project.

The geologic units that underlie the Project region are depicted in the Santa Rosa Quadrangle geologic map of the California Division of Mines and Geology Regional Geologic Map Series (Wagner and Bortugno 1982) and described in the geology of the Santa Rosa Quadrangle (Wagner and Bortugno 1983). The oldest geologic units in the vicinity of the Project east of the San Andreas Fault are the Franciscan Complex, which is Jurassic to Early Cretaceous in age and the Great Valley Group which is Early Cretaceous. The Franciscan Complex consists of folded and faulted sandstones, shale, conglomerate, chert, greenstone, and serpentinite rocks. In some areas these rocks occur as large intact blocks, and in others may occur as melange (meaning a mixture of rocks).[1] The Great Valley Group consists of marine mudstones, sandstones, and conglomerates. Much younger Miocene to Pliocene sedimentary rocks, including the Wilson Grove Formation[2] (marine sandstone, conglomerate, and tuff) and the Petaluma Formation (mostly non-marine claystone, mudstone, and siltstone) were deposited on top of the Franciscan Complex. During Pliocene time, volcanic activity occurred and resulted in the widespread deposition of the Sonoma Volcanics (basalt, andesite, rhyolite, tuff, and other volcanic rocks) in the eastern portion of the County. Pleistocene to Holocene alluvium, including the Glen Ellen Formation, in northwest-trending valleys constitutes the youngest geologic unit in the area.

South County

Proposed South County reservoir sites are located in the western foothills of the Sonoma Mountains where they border Petaluma Valley. The main geologic formations in this part of the Project region are the Petaluma Formation and the Sonoma Volcanics, both of Pliocene age. However, some relatively small areas are underlain by Franciscan Complex rocks which are in fault contact with the Pliocene rocks. The following description of site specific geologic conditions is

[1] A chaotic mixture of intact sandstone, greenstone, blueschist, silica-carbonate, and chert in a sheared or crushed matrix of shale.
[2] This unit was formerly known as the Merced Formation and is currently referred to as the Wilson Grove Formation.

based on the *Geotechnical Assessment of Alternative Reservoir Sites and Pipeline Alignments* (Rust Environment & Infrastructure 1995). All reservoir geology figures are found together at the end of this discussion.

Tolay Extended and Tolay Confined Reservoir Sites

The Tolay Creek main dam site is located on a relatively narrow constriction of Tolay Creek, immediately downstream of the broad, flat-floored valley of Tolay Creek. At the main dam site maximum slopes are about 1.5:1 (horizontal to vertical[3]) with elevations ranging from 180 to 300 feet above mean sea level.

The reservoir site is underlain by rocks of the Petaluma Formation (claystone and sandstone), Sonoma Volcanics (andesite, rhyolite, and tuff), and Franciscan Complex. Franciscan Complex rocks are found at higher elevations at the reservoir site and consist of melange (Figure 4.3-2). Alluvial deposits occur in the flattest portions of the valley floor and range in thickness from 25 to 30 feet.

The main dam site is underlain by claystone of the Petaluma Formation and rhyolites of the Sonoma Volcanics. Thick old landslide deposits consisting of rocks from these two formations have been interpreted based on results of subsurface exploration at the main dam site. The north saddle dam is underlain entirely by claystone and sandstone of the Petaluma Formation. The west saddle dam is underlain by claystone of the Petaluma Formation on the north abutment and old landslide deposits on the south abutment. The back dam, which crosses the broad valley, is underlain by silty clay to clayey sand material.

Few landslides were mapped at these reservoir sites during site reconnaissance. Rocks of the Petaluma Formation and soil-like units of the Sonoma Volcanics are prone to landsliding. However, because of the gentle slopes surrounding the valley floor the risk of landsliding at this site is moderate (Rust Environment and Infrastructure 1995).

The Tolay Fault trends northwesterly through the proposed main dam, back dam, and west saddle dam. This fault is not considered to be active based on the California Division of Mines and Geology fault evaluation (discussed in the Fault section below).

Adobe Road Reservoir Site

The Adobe Road dam site is located in a broad valley that contains an incised creek. Elevations at the site range from approximately 275 to 375 feet above mean sea level. Maximum slopes at the dam site are about 2:1.

---

[3] Throughout this report slope gradients will be reported in a ratio of horizontal distance to vertical distance.

The entire site is underlain by sedimentary rocks of the Petaluma Formation consisting of claystone and siltstone with interbeds of sandstone and pebbly conglomerate (Figure 4.3-3). Bedding orientation is variable possibly as a result of folding and landsliding; however, the general orientation of bedding is northwest with moderate to steep dips to both the northeast and southwest.

Numerous recent landslides exist within and above the reservoir area. The landslides range in size from 10 feet wide to 300 feet wide. Geotechnical investigations at the site suggest that older landslides are deeper and more extensive at this site than at other reservoir sites (Figure 4.3-5). Evaluation of existing landslides, topography, and geologic materials indicates that the risk of landsliding at this site is high (Rust Environment and Infrastructure 1995).

Sears Point Reservoir Site

The Sears Point dam site is located in the broad, flat-floored valley of Tolay Creek. Maximum slopes on the abutments of the dam site are about 4:1. Elevations at the Sears Point site range from approximately 30 feet to 155 feet above mean sea level.

Most of the reservoir site is underlain by soft, friable, and massive claystone of the Petaluma Formation. Minor outcrops of limestone, andesite, and tuff occur throughout the site (Figure 4.3-4). Alluvium, consisting mainly of clay and clayey sand, underlies the flat valley floor and ranges in thickness from about 30 to 40 feet. Several springs were mapped during field reconnaissance.

Numerous recent and old landslides are present at the site and are associated with the expansive Petaluma Formation claystone (Figure 4.3-4). Some of these slides are up to 400 feet wide and extend downslope as much as 1,000 feet. Evaluation of existing landslides, topography, and geologic materials indicates that the risk of landsliding at this site is moderate (Rust Environment and Infrastructure 1995). Thicker and more extensive landslide deposits are present in the western portion of the reservoir site.

Lakeville Hillside Reservoir Site

The Lakeville Hillside dam site is located in a broad flat valley that has relatively steep side slopes, especially in tributary channels. Elevations at the Lakeville Hillside site range from approximately 140 to 200 feet above mean sea level. Maximum slopes at the dam site are about 2:1.

The entire site is underlain by sedimentary rocks of the Petaluma Formation, consisting of claystone and siltstone with interbeds of sandstone and pebbly conglomerate (Figure 4.3-5). Bedding orientation is generally northeast with moderate dips to both the west and the east.

Several recent landslides are present within and above the reservoir area. The landslides range in size from 10 feet wide to 500 feet wide (Figure 4.3-5). Evaluation of existing landslides, topography, and geologic materials indicates that the risk of landsliding at this site is high (Rust Environment and Infrastructure 1995).

West County

The West County region includes the hilly areas bounded by the Santa Rosa Plain to the east and Bodega Bay to the west. The predominant geologic formation is the Pliocene-age Wilson Grove Formation, which consists mostly of marine sedimentary rocks. The Wilson Grove Formation underlies a relatively extensive area of this portion of the Coast Ranges which is underlain by older bedrock units of the Franciscan Complex and the Great Valley Group.

Two Rock Reservoir Site

The Two Rock dam site is located in a broad steep-sided canyon about 400 feet wide. Elevations at the site range from approximately 150 to 360 feet above mean sea level. Maximum slopes at the dam site are about 2:1.

The entire reservoir site is underlain by rocks of the Franciscan Complex, consisting of a melange (Figure 4.3-6). The Wilson Grove Formation occurs as a cap on the Franciscan Complex bedrock and is found on ridges surrounding the proposed reservoir. Surficial deposits overlying the bedrock include alluvium along the creek channel and colluvium on lower slopes.

Few landslides were mapped at the Two Rock reservoir site. Evaluation of existing landslides, topography, and geologic materials indicates that the risk of landsliding at this site is low (Rust Environment and Infrastructure 1995).

The Dunham Fault trends northwesterly through the eastern portion of the reservoir. The Bloomfield Fault is located about 2,000 feet southwest of the Two Rock dam site. Neither of these faults is considered to be active based on the California Division of Mines and Geology fault evaluation (discussed below).

Bloomfield Reservoir Site

The Bloomfield dam site is located in a narrow valley with flat to gently sloping sides. Elevations at this site range from 80 to 280 feet above mean sea level. Maximum slopes at the dam site are about 2:1.

The major bedrock unit at the reservoir site is the Wilson Grove Formation, consisting predominantly of massive, soft, weakly cemented siltstone to very fine sandstone (Figure 4.3-7). Franciscan Complex bedrock consisting of sheared shale and sandstone occurs north of the Bloomfield Fault, in the northern portion

of the reservoir. Alluvial deposits blanket the flat, narrow valley floor and the broader valley floor at the northern portion of the site.

A few minor landslides are present at this site and a few erosional features, such as gullies and rills, are mapped (Figure 4.3-7). Evaluation of existing landslides, topography, and geologic materials indicates that the risk of landsliding at this site is low (Rust Environment and Infrastructure 1995).

The Bloomfield Fault trends northwesterly through the northern portion of the reservoir. This fault is an Early Quaternary fault and is not considered to be active based on the California Division of Mines and Geology fault evaluation (discussed below).

Carroll Road Reservoir Site

The Carroll Road dam site is located in a relatively narrow valley. Maximum slopes at the site are about 3:1. Elevations range from approximately 80 feet to 265 feet above mean sea level.

Most of the reservoir site is underlain by the Wilson Grove Formation, consisting of soft, friable, massive sandy siltstone to silty sandstone (Figure 4.3-8). Franciscan Complex bedrock occurs in a small area in the northern portion of the reservoir site. Bedding at the site is mostly flat lying to gently dipping. Alluvium ranging in thickness from about 25 to 30 feet occurs in the flat portions of the valley floor.

Most of the landslides mapped within the Carroll Road site are small and can be attributed to erosion or the presence of springs. Evaluation of existing landslides, topography, and geologic materials indicates that the risk of landsliding at this site is low (Rust Environment and Infrastructure 1995).

Valley Ford Reservoir Site

The Valley Ford dam site is located in a broad valley with flat to gently sloping sides. Maximum slopes in the dam site area are about 3.5:1. Elevations at the Valley Ford site range from approximately 30 to 160 feet above mean sea level.

The entire reservoir site is underlain by the bedrock of the Wilson Grove Formation consisting of massive, soft, weakly cemented sandy siltstone and siltstone (Figure 4.3-9). Bedding is typically close to horizontal. Alluvial deposits consisting of clay, sand, and silt overlie bedrock in the stream channel and are about 16 feet thick. The lower and flatter slopes of the valley are covered with several feet of clayey sand colluvium.

Numerous gullies are present in the Wilson Grove Formation indicating that the bedrock is potentially erodible, particularly in areas of concentrated surface water flow. A few minor landslides occur at this site and most are associated with

incised erosion scars that follow steep drainage courses (Figure 4.3-9). Evaluation of existing landslides, topography, and geologic materials indicates that the risk of landsliding at this site is low (Rust Environment and Infrastructure 1995).

Huntley Reservoir Site

The Huntley reservoir site is located within a broad valley with gentle slopes. Maximum slope gradients at the site are approximately 2:1. Elevations at the site range from 100 to 260 feet above mean sea level.

The Huntley dam and reservoir site is underlain by Franciscan melange and the Wilson Grove Formation (weakly cemented sandstone and siltstone) (Figure 4.3-10). The older Franciscan Complex rocks occur in the valley floor and lower slopes. The younger Wilson Grove Formation occurs in depositional contact with the Franciscan and is found at the upper portions of slopes and on ridges. The contact between the Wilson Grove Formation and Franciscan Complex appears to dip gently toward the north Creek bank slumping, and minor shallow earth flows were observed at the site during field reconnaissance. However, no evidence of large, deep-seated landsliding or major slope instability was observed. Evaluation of existing landslides, topography, and geologic materials indicates that the risk of landsliding at this site is low (Rust Environment and Infrastructure 1995).

The Geysers Geothermal Resource Area

The geysers geothermal resource area is located in the Mayacmas Mountains in the northeastern most portion of Sonoma County and a smaller adjoining portion of Lake and Mendocino counties (Figure 4.3-11). This highland area is made up of a series of rugged northwest-trending ridges and valleys. The central ridge of the northwest-trending Mayacmas Mountains forms the boundary between Lake County on the east and Sonoma County on the west and extends into Mendocino County. Topography at the geysers is steep and rugged. Elevations range from just over 1,000 feet in the base of Big Sulphur Creek to a maximum of about 3,600 feet along the ridge near the Lake County line.

The main ridge of the northwest trending Mayacmas Mountains is a prominent drainage divide. Creeks on the west side of the ridge flow toward the northwest joining the Russian River near Cloverdale. Creeks on the east side flow both northeastward toward Clear Lake and southeastward into Lake Berryessa.

Throughout the geysers area, bedrock consists predominantly of the Franciscan Complex, which includes marine sandstone, shale, volcanic rocks, and serpentinite. The Franciscan rocks in this area are intensely fractured and degraded by hydrothermal (hot water) alteration due to infusion with hot, mineral-rich water. At the geysers, soil cover is generally thin and bedrock lies at or near the surface. Bedrock of other formations is scarce within the geysers area.

Pyroclastic (erupted volcanic material) and flow rocks of the Pleistocene Clear Lake Volcanics occur east of the Project area at Cobb Mountain, Boggs Mountain, and Mt. Hannah. Deep magma chambers such as those responsible for the Clear Lake Volcanics are presumed to contribute the heat that generates steam at the geysers.

Unusual geologic conditions at the geysers, including open fractures in bedrock at great depth and heat from probable shallow magma chambers, produce natural steam. The steam was first used in the 1920s for generating electricity for a resort hotel along Big Sulphur Creek. Commercial development for power production began in 1955, and increased in the 1960s when twelve wells began to supply steam to an 11-megawatt power plant built by Pacific Gas and Electric. In 1966, power production increased to 51 megawatts, and by 1978 approximately 95 wells delivered steam to eleven power plants, with a total capacity of 502 megawatts. Power production reached a peak in the late 1980s.

Beginning in 1969, water discharge limitations set by the Regional Water Quality Control Board required that the effluent water (water that had condensed after steam production) be disposed of by re-injection. Currently a limited amount of water from Big Sulphur Creek is diverted and injected on a seasonal basis to enhance steam production. Injection of water from the Lake County Sanitary District into portions of the steamfield has been approved and is included as a Cumulative Project.

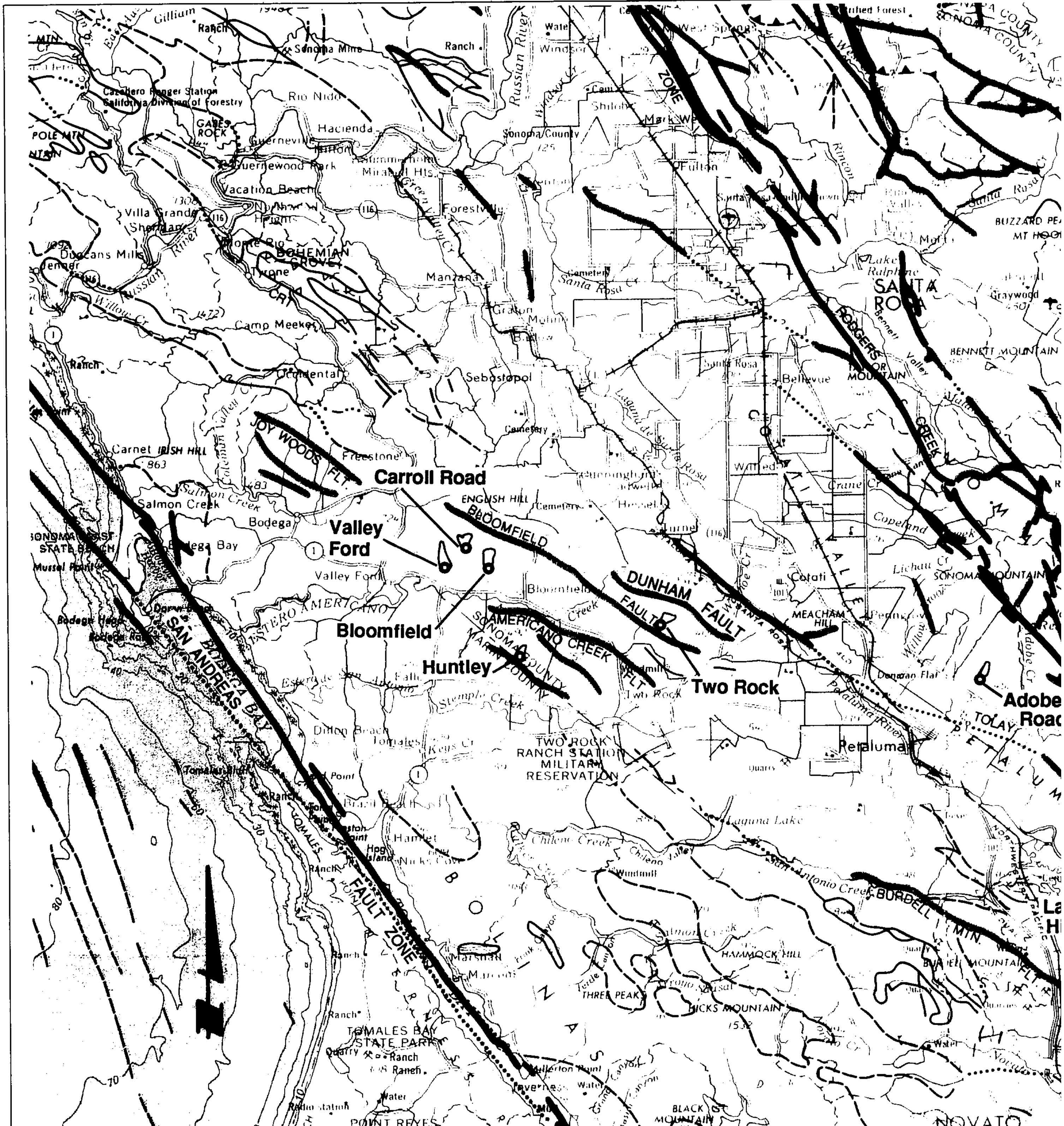
The structural grain of the geysers area is controlled by generally northwest oriented faults of several generations. The bedrock in the geysers area is intensely faulted and fractured. Older apparently inactive faults are abundant and cross-cut by younger faults. Faults in the geysers are further discussed under Historical Seismicity, below.

The Geysers Pipeline Alignment

The discussion of the geologic setting along the geysers pipeline alignment is divided into four segments according to topographic characteristics and bedrock type. Geologic and seismic hazards along pipeline routes are shown in two figures, the Southern Project Area (Figure 4.3-12) and the Northern Project Area (Figure 4.3-13). The description of this portion of the project is based on the *Geotechnical Assessment of Alternative Reservoir Sites and Pipeline Routes* (Rust Environment and Infrastructure, Inc. 1995).

Delta Pond near Santa Rosa Creek to the Pleasant Avenue/Chalk Hill Road Intersection east of Windsor

This gently sloping area is underlain by alluvium along Santa Rosa, Mark West, and Windsor creeks between Windsor and Santa Rosa. The alluvium is underlain by the Pleistocene Glen Ellen Formation which consists of older deposits of



BASE FROM BORTUGNO, E.J. (COMPILER), 1982, MAP SHOWING RECENCY OF FAULTING, SANTA ROSA QUADRANGLE 1:250,000 IN CALIFORNIA DIVISION OF MINES AND GEOLOGY, REGIONAL MAP SERIES MAP NO. 2A.

Source: Rust Environment & Infrastructure

HARLAND BARTHOLOMEW & ASSOCIATES, INC.

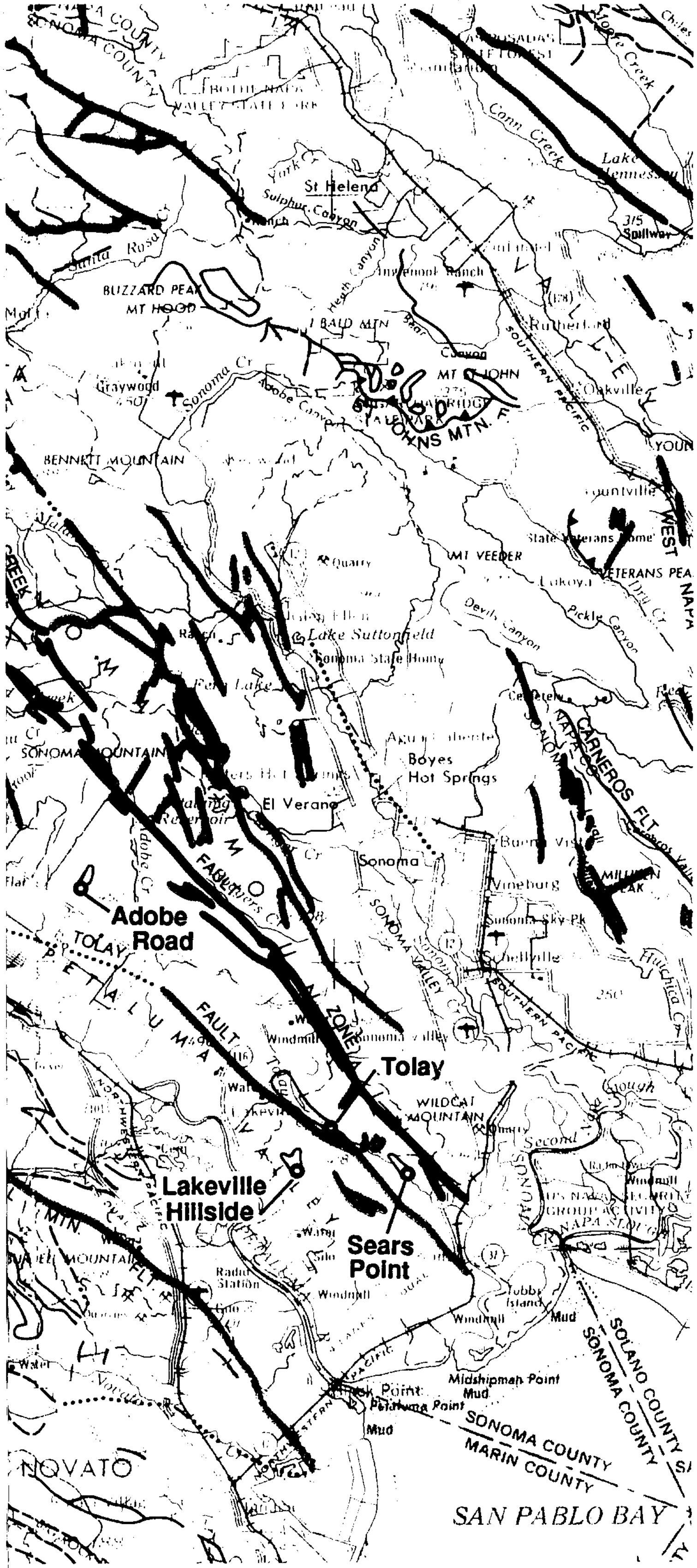
PARSONS ENGINEERING SCIENCE, INC.

UNITS OF PARSONS INFRASTRUCTURE & TECHNOLOGY INC.

PARSONS

Santa Rosa

(1)



Geologic Time Scale			Years Before Present (Approx.)	Fault Symbol	Recency of Movement	DESCRIPTION ON LAND
Quaternary - Potentially Active	Late Quaternary	Historic	200			Displacement during historic ti (e.g. San Andreas Fault 1906). Includes areas of known fault c
		Holocene	10,000			Displacement during Holocene time.
		Pleistocene	700,000			Faults showing evidence of displacement during late Quaternary time.
	Early Quaternary		2,000,000			Quaternary (undifferentiated) faults - most in this category show evidence of displacement during the last 2,000,000 years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age.
Pre-Quaternary - Inactive		Pliocene	5,000,000			Fault showing evidence of no displacement during Quatemar time or faults without recogniz Quaternary displacement.
		Miocene				

FAULT MAP SYMBOLS

ON LAND

Solid where well located; dashed where approximately located or inferred; dotted where concealed by younger rocks, lakes or bays; queried where continuation or existence is uncertain. Barbs indicate thrust fault (barbs on upper plate). Arrows indicate relative or apparent direction of movement.

Two Rock — ALTERNATIVE RESERVOIR STORAGE SITE

SCALE

0 — 5 — 10 MILES

1:250,000

nta Rosa Subregional Long-Term Wastewater Project

REGIONAL FAULTS

Figure 4

(2)

ars ore ent rox.)	Fault Symbol	Recency of Movement	DESCRIPTION ON LAND
			Displacement during historic time (e.g. San Andreas Fault 1906). Includes areas of known fault creep.
0			Displacement during Holocene time.
00			Faults showing evidence of displacement during late Quaternary time.
,000			Quaternary (undifferentiated) faults - most in this category show evidence of displacement during the last 2,000,000 years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age.
),000			
),000			Fault showing evidence of no displacement during Quaternary time or faults without recognized Quaternary displacement.

FAULT MAP SYMBOLS

ON LAND

? ?

well located; dashed where approximately located or inferred; concealed by younger rocks, lakes or bays; queried where con- existence is uncertain. Barbs indicate thrust fault (barbs on upper ws indicate relative or apparent direction of movement.

LTERNATIVE RESERVOIR STORAGE SITE

SCALE

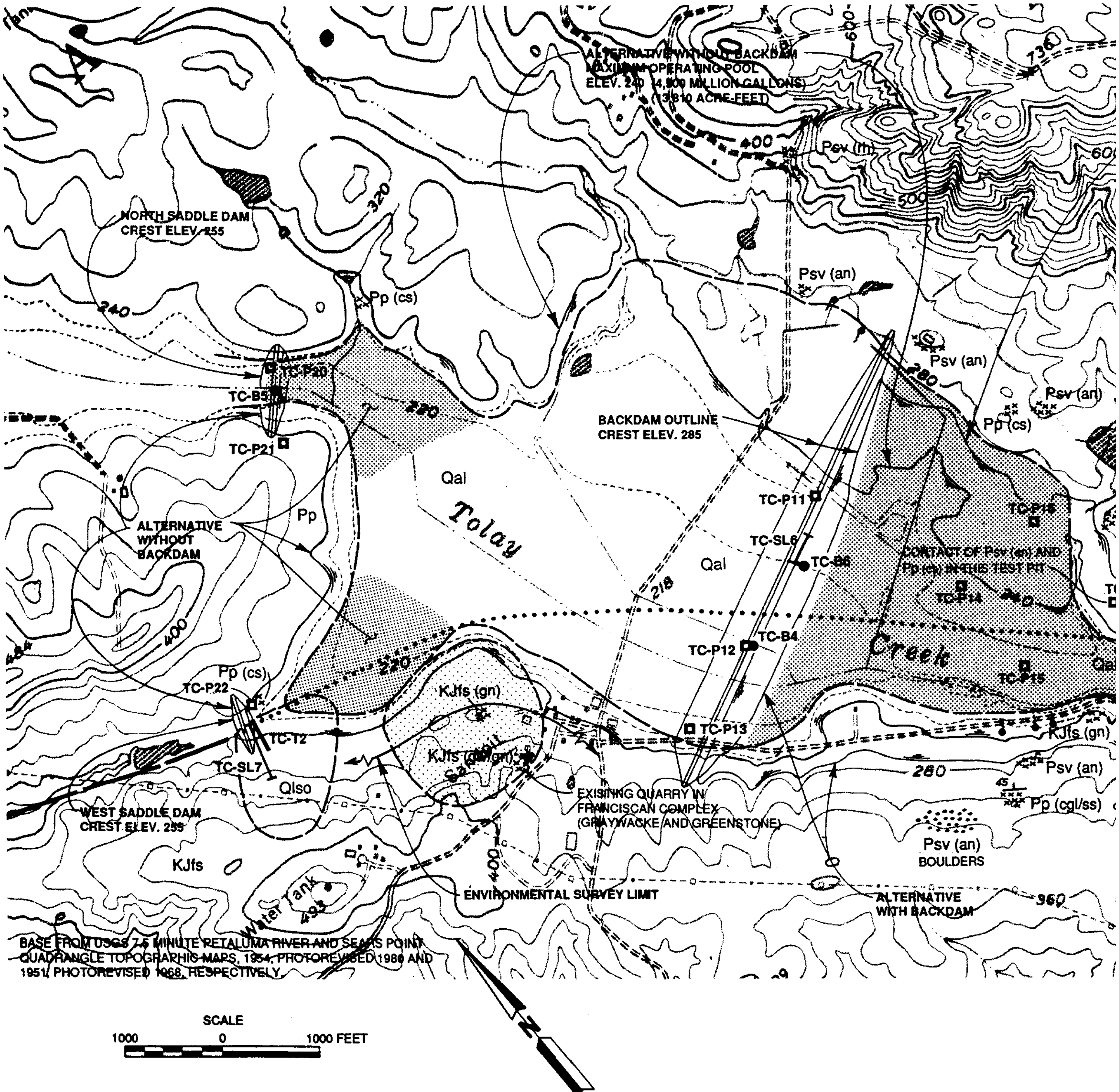
5 10 MILES

1:250,000

REGIONAL FAULTS

Figure 4.3-1

(1)

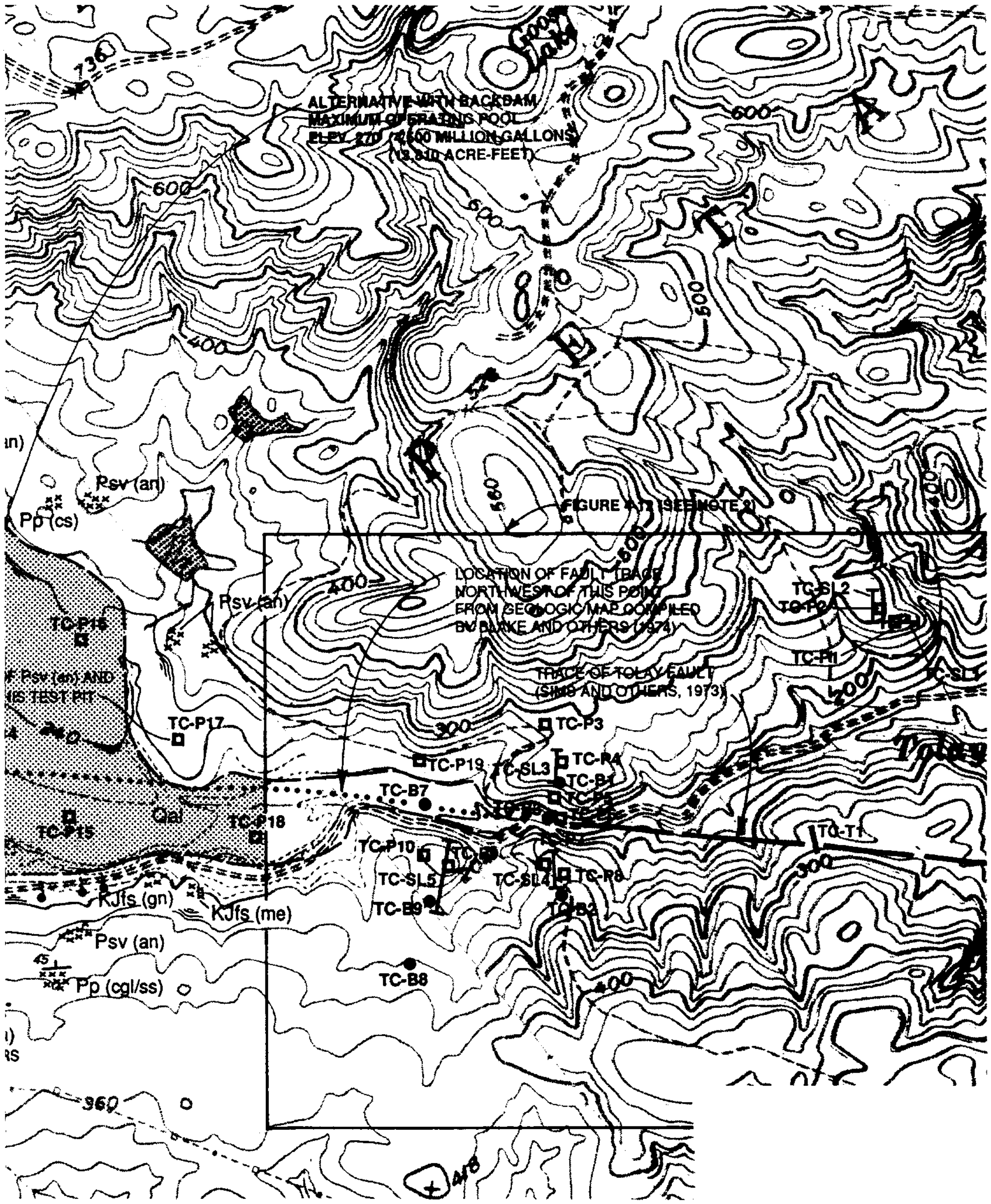


Source: RUST Environment & Infrastructure

HARLAND BARTHOLOMEW & ASSOCIATES, INC.
PARSONS ENGINEERING SCIENCE, INC.
UNITS OF PARSONS INFRASTRUCTURE & TECHNOLOGY INC.

PARSONS

Santa Rosa



LEGEND

EXPLANATION

Qal	ALLUVIUM: SILTY CLAY TO SANDY CLAY; INTERBE WITH CLAYEY SAND; LOCALLY, LENSES OF SILTY GRAVELLY SANDS.
Qlso	OLD LANDSLIDE DEPOSIT: SILTY CLAY TO SAND CLAY.
Pp	PETALUMA FORMATION: PLIOCENE AGE; SHOWI WHERE NOTED IN EXPOSURES; INCLUDES CLAYS (cs), SANDSTONE (ss) AND CONGLOMERATE (cgl).
Psv	SONOMA VOLCANICS: PLIOCENE AGE; SHOWN W NOTED IN EXPOSURES; INCLUDES ANDESITE (an) RHYOLITE (rh), ASHFLOW TUFF (tf), AGGLOMERAT
KJfs	FRANCISCAN COMPLEX: SHOWN WHERE NOTED EXPOSURES; INCLUDES GRAYWACKE (gw), GREE STONE (gn), MELANGE (me).

APPROXIMATE GEOLOGIC CONTACT

FAULT, DASHED WHERE UNCERTAIN, DOTTED WHERE CONCEALED

45 STRIKE AND DIP OF BEDDING

cs an OBSERVED OUTCROP

SPRING

TC-B9 ● EXPLORATION BORING

TC-P22 ◘ TEST PIT

TC-T2 EXPLORATION TRENCH

TC-SL5 SEISMIC LINE

NOTES: 1. GEOLOGIC FEATURES SHOWN INCLUDING OUTCROPS SPRINGS AND LANDSLIDES WERE NOTED DURING SIT RECONNAISSANCE MAPPING ON OCTOBER 12-13, 199 AND OCTOBER 28-31, 1994.

2. SEE FIGURE 4-12 FOR SITE GEOLOGIC AND EXPLORAT MAP OF THE TOLAY CREEK MAIN DAM SITE AREA, INC GEOLOGIC FEATURES, DAM LAYOUT, AND BORROW A

IMPERVIOUS BORROW AREA

EARTH/ROCK BORROW AREA (OUTSIDE RESERVOIR - ONLY AREA WITHIN SURVEY LIMIT ASSUMED FOR DESIGN)

NOTE: ONLY THE PRIMARY IMPERVIOUS BORROW SOURCE ARE POTENTIAL EARTH/ROCK BORROW SOURCE AREA OUTS RESERVOIR AREA ARE SHOWN. SOURCES OF OTHER ON CONSTRUCTION MATERIALS WITHIN THE RESERVOIR AR NOT OUTLINED. REFER TO THE REPORT FOR EXPLANAT ALL BORROW SOURCES.

ta Rosa Subregional Long-Term Wastewater Project

GEOLOGY of the TOLAY RESERVOIR SITE

Figure 4.

LEGEND

EXPLANATION

Qal	ALLUVIUM: SILTY CLAY TO SANDY CLAY; INTERBEDDED WITH CLAYEY SAND; LOCALLY, LENSES OF SILTY TO GRAVELLY SANDS.
Qlso	OLD LANDSLIDE DEPOSIT: SILTY CLAY TO SANDY CLAY.
Pp	PETALUMA FORMATION: PLIOCENE AGE; SHOWN WHERE NOTED IN EXPOSURES; INCLUDES CLAYSTONE (cs), SANDSTONE (ss) AND CONGLOMERATE (cgl).
Psv	SONOMA VOLCANICS: PLIOCENE AGE; SHOWN WHERE NOTED IN EXPOSURES; INCLUDES ANDESITE (an), RHYOLITE (rh), ASHFLOW TUFF (tf), AGGLOMERATE (ag).
KJfs	FRANCISCAN COMPLEX: SHOWN WHERE NOTED IN EXPOSURES; INCLUDES GRAYWACKE (gw), GREENSTONE (gn), MELANGE (me).

— — —	APPROXIMATE GEOLOGIC CONTACT
▬ ▬ • • •	FAULT, DASHED WHERE UNCERTAIN, DOTTED WHERE CONCEALED
45	STRIKE AND DIP OF BEDDING
CS xxx an	OBSERVED OUTCROP
	SPRING
TC-B9 ●	EXPLORATION BORING
TC-P22 ◻	TEST PIT
TC-T2	EXPLORATION TRENCH
TC-SL5	SEISMIC LINE

NOTES: 1. GEOLOGIC FEATURES SHOWN INCLUDING OUTCROPS, SPRINGS AND LANDSLIDES WERE NOTED DURING SITE RECONNAISSANCE MAPPING ON OCTOBER 12-13, 1994 AND OCTOBER 28-31, 1994.

2. SEE FIGURE 4-12 FOR SITE GEOLOGIC AND EXPLORATION MAP OF THE TOLAY CREEK MAIN DAM SITE AREA, INCLUDING GEOLOGIC FEATURES, DAM LAYOUT, AND BORROW AREAS.

IMPERVIOUS BORROW AREA

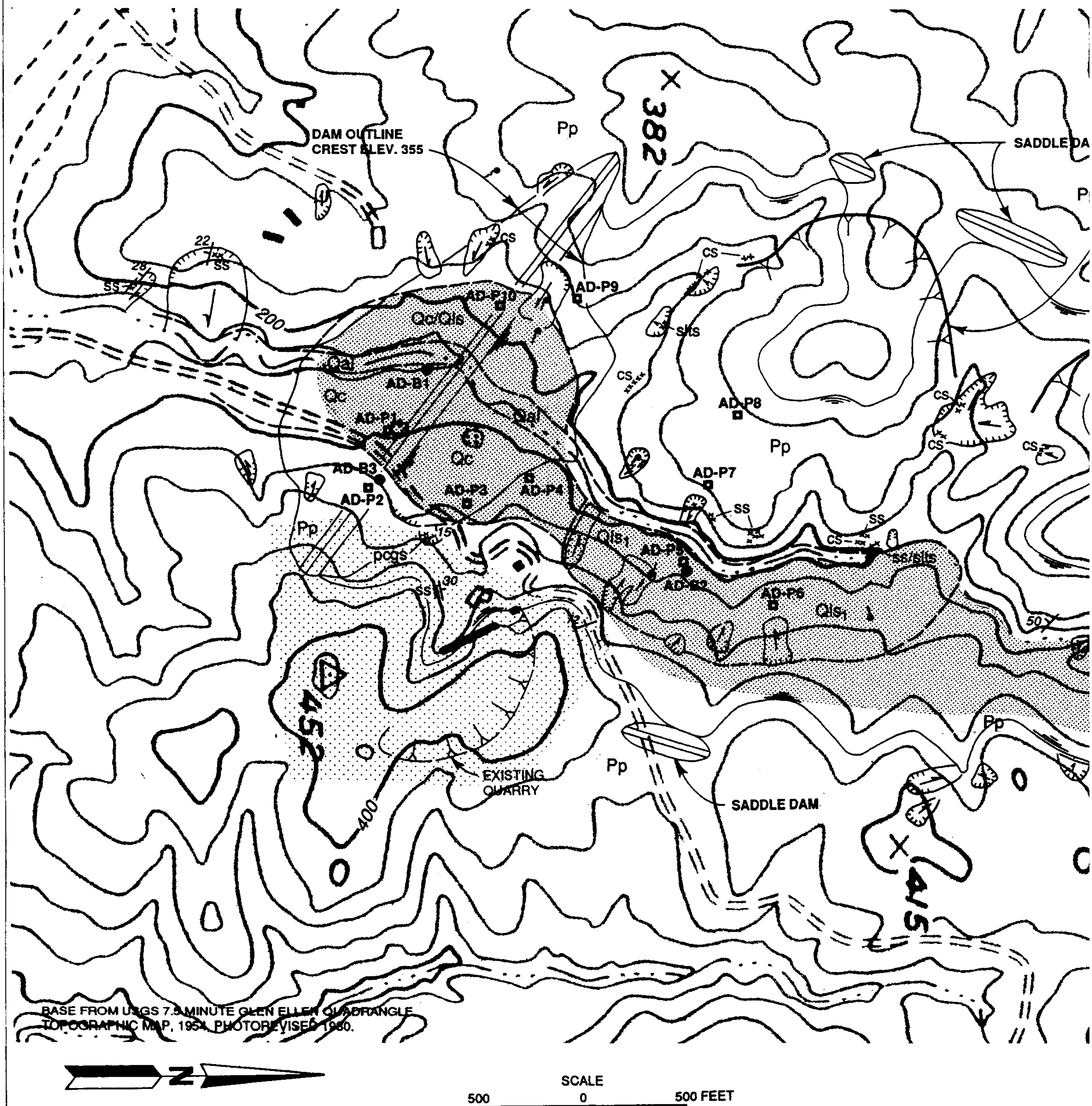
EARTH/ROCK BORROW AREA (OUTSIDE RESERVOIR - ONLY AREA WITHIN SURVEY LIMIT ASSUMED FOR DESIGN)

NOTE: ONLY THE PRIMARY IMPERVIOUS BORROW SOURCE AREAS AND POTENTIAL EARTH/ROCK BORROW SOURCE AREA OUTSIDE THE RESERVOIR AREA ARE SHOWN. SOURCES OF OTHER ON-SITE CONSTRUCTION MATERIALS WITHIN THE RESERVOIR AREA ARE NOT OUTLINED. REFER TO THE REPORT FOR EXPLANATION OF ALL BORROW SOURCES.

Figure 4.3-2

GEOLOGY of the TOLAY RESERVOIR SITE

(1)



Source: RUST Environment & Infrastructure

HARLAND BARTHOLOMEW & ASSOCIATES, INC.

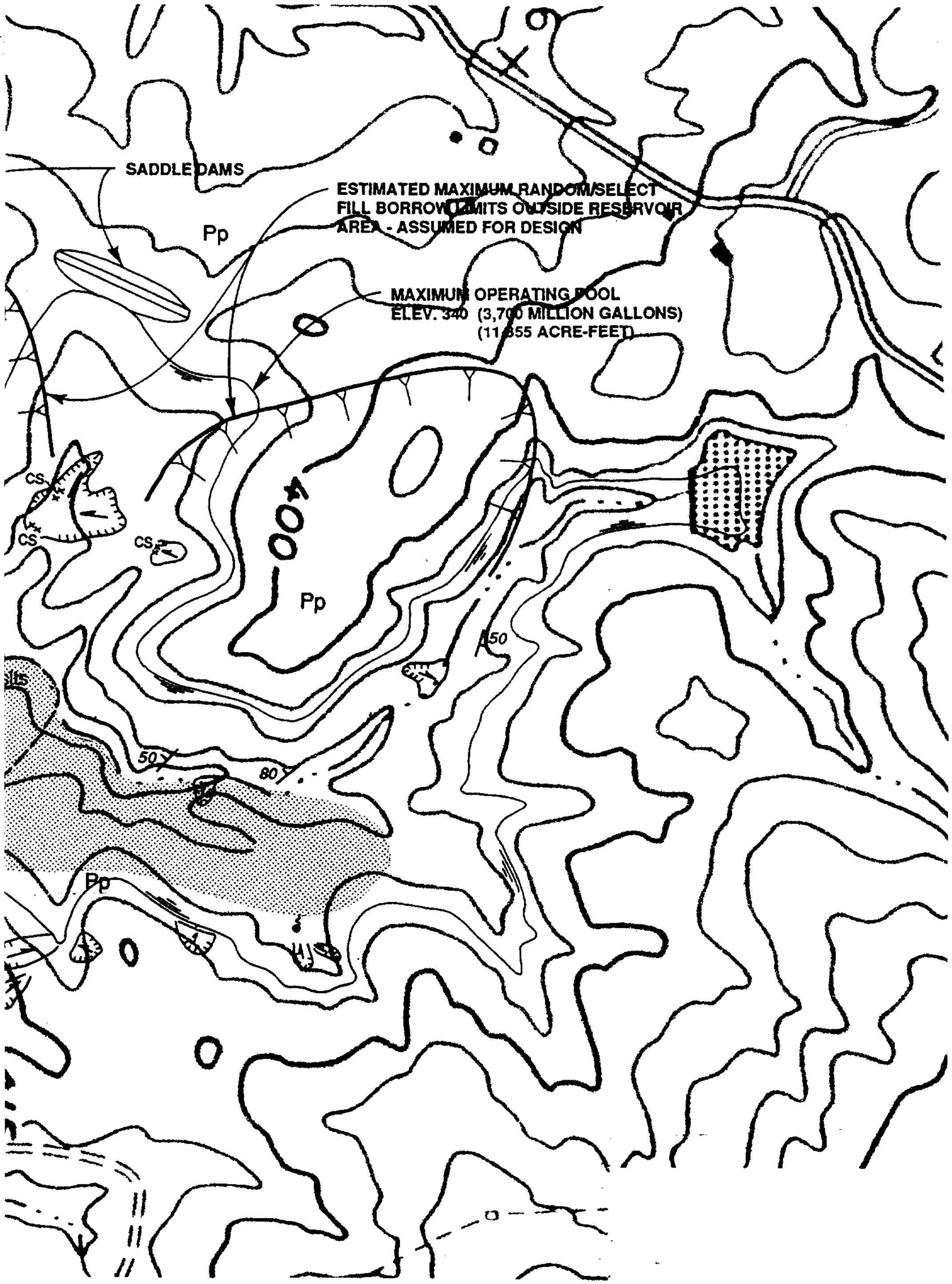
PARSONS ENGINEERING SCIENCE, INC.

UNITS OF PARSONS INFRASTRUCTURE & TECHNOLOGY INC.

PARSONS

Santa Rosa

(2)



LEGEND

Qal	RECENT ALLUVIUM: MIXED CLAY, SA GRAVEL ALONG ACTIVE STREAM CH
Qc	COLLUVIUM: CLAY; SANDY CLAY; CLA OCCURS ON LOWER FLATTER HILLS ATTAINS THICKNESS ON THE ORDER 20 FEET; MAY BE ASSOCIATED WITH LANDSLIDE DEPOSITS.
Qls_1	LANDSLIDE DEPOSIT: CLAY AND SHE CLAYSTONE; INTERPRETED FROM E TION TEST PITS AND BORINGS ON E OF PROPOSED RESERVOIR.
Qc/Qls	COLLUVIUM/LANDSLIDE DEPOSITS: UNDIFFERENTIATED.
Pp	PETALUMA FORMATION: PLIOCENE NON-MARINE; COMPRISED OF MASS CLAYSTONE (cs), SILTSTONE (slts), W INTERBEDDED SANDSTONE (ss) AND CONGLOMERATE/SANDSTONE (pcgs)
	APPROXIMATE GEOLOGIC CONTACT
15	STRIKE AND DIP OF BEDDING
CS ××× slts	OBSERVED OUTCROP
	SPRING
	LANDSLIDE
AD-B3 ●	EXPLORATION BORING
AD-P10 ◘	TEST PIT

NOTE: GEOLOGIC FEATURES SHOWN INCLUDING OU SPRINGS, AND LANDSLIDES WERE NOTED DU RECONNAISSANCE MAPPING ON SEPTEMBER

	IMPERVIOUS BORROW AREA
	POTENTIAL ADDITIONAL SELECT FILL BORROW AREA (OUTSIDE RESERVOIR AREA - NOT ASSUMED FOR DESIGN)

NOTE: ONLY THE PRIMARY IMPERVIOUS BORROW SOUR AND POTENTIAL ADDTITIONAL SELECT FILL BORR AREA OUTSIDE THE RESERVOIR AREA ARE SHOW OF OTHER ON-SITE CONSTRUCTION MATERIALS W RESERVOIR AREA ARE NOT OUTLINED. REFER TO FOR EXPLANATION OF ALL BORROW SOURCES.

Santa Rosa Subregional Long-Term Wastewater Project

Figu

GEOLOGY of the ADOBE ROAD RESERVOIR SITE

3

LEGEND

Qal	RECENT ALLUVIUM: MIXED CLAY, SAND AND GRAVEL ALONG ACTIVE STREAM CHANNEL.
Qc	COLLUVIUM: CLAY; SANDY CLAY; CLAYEY SAND; OCCURS ON LOWER FLATTER HILLSIDE SLOPES; ATTAINS THICKNESS ON THE ORDER OF 15 TO 20 FEET; MAY BE ASSOCIATED WITH OLD LANDSLIDE DEPOSITS.
Qls_1	LANDSLIDE DEPOSIT: CLAY AND SHEARED CLAYSTONE; INTERPRETED FROM EXPLORATION TEST PITS AND BORINGS ON EAST SIDE OF PROPOSED RESERVOIR.
Qc/Qls	COLLUVIUM/LANDSLIDE DEPOSITS: UNDIFFERENTIATED.
Pp	PETALUMA FORMATION: PLIOCENE AGE; MOSTLY NON-MARINE; COMPRISED OF MASSIVE CLAYSTONE (cs), SILTSTONE (slts), WITH INTERBEDDED SANDSTONE (ss) AND PEBBLY CONGLOMERATE/SANDSTONE (pcgs).
— — —	APPROXIMATE GEOLOGIC CONTACT
15	STRIKE AND DIP OF BEDDING
cs ××× slts	OBSERVED OUTCROP
	SPRING
	LANDSLIDE
AD-B3 ●	EXPLORATION BORING
AD-P10 ◘	TEST PIT

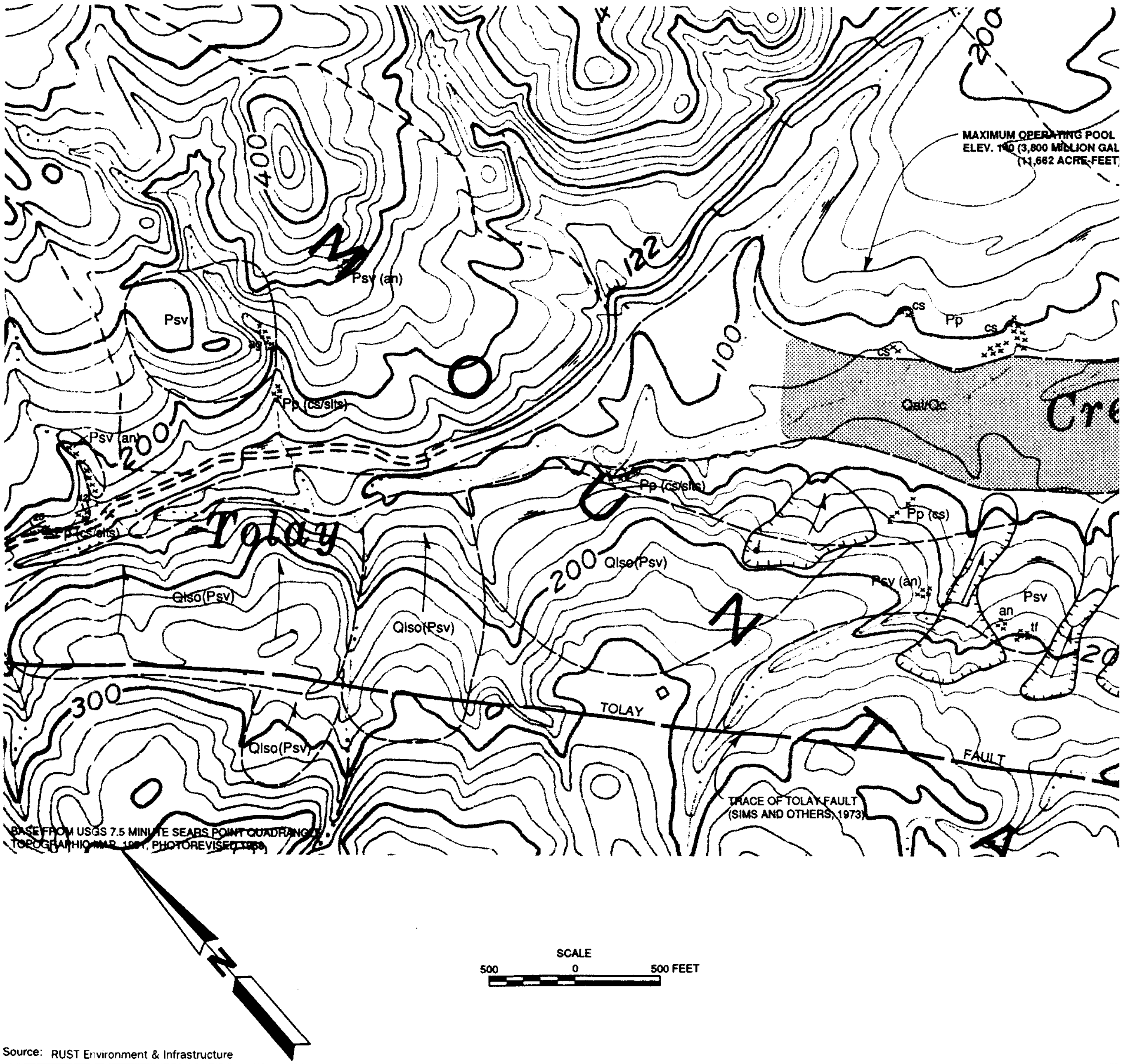
NOTE: GEOLOGIC FEATURES SHOWN INCLUDING OUTCROPS, SPRINGS, AND LANDSLIDES WERE NOTED DURING SITE RECONNAISSANCE MAPPING ON SEPTEMBER 12-13, 1994.

	IMPERVIOUS BORROW AREA
	POTENTIAL ADDITIONAL SELECT FILL BORROW AREA (OUTSIDE RESERVOIR AREA - NOT ASSUMED FOR DESIGN)

NOTE: ONLY THE PRIMARY IMPERVIOUS BORROW SOURCE AREAS AND POTENTIAL ADDTITIONAL SELECT FILL BORROW SOURCE AREA OUTSIDE THE RESERVOIR AREA ARE SHOWN. SOURCES OF OTHER ON-SITE CONSTRUCTION MATERIALS WITHIN THE RESERVOIR AREA ARE NOT OUTLINED. REFER TO THE REPORT FOR EXPLANATION OF ALL BORROW SOURCES.

Figure 4.3-3

GEOLOGY of the ADOBE ROAD RESERVOIR SITE



Source: RUST Environment & Infrastructure

HARLAND BARTHOLOMEW & ASSOCIATES, INC.

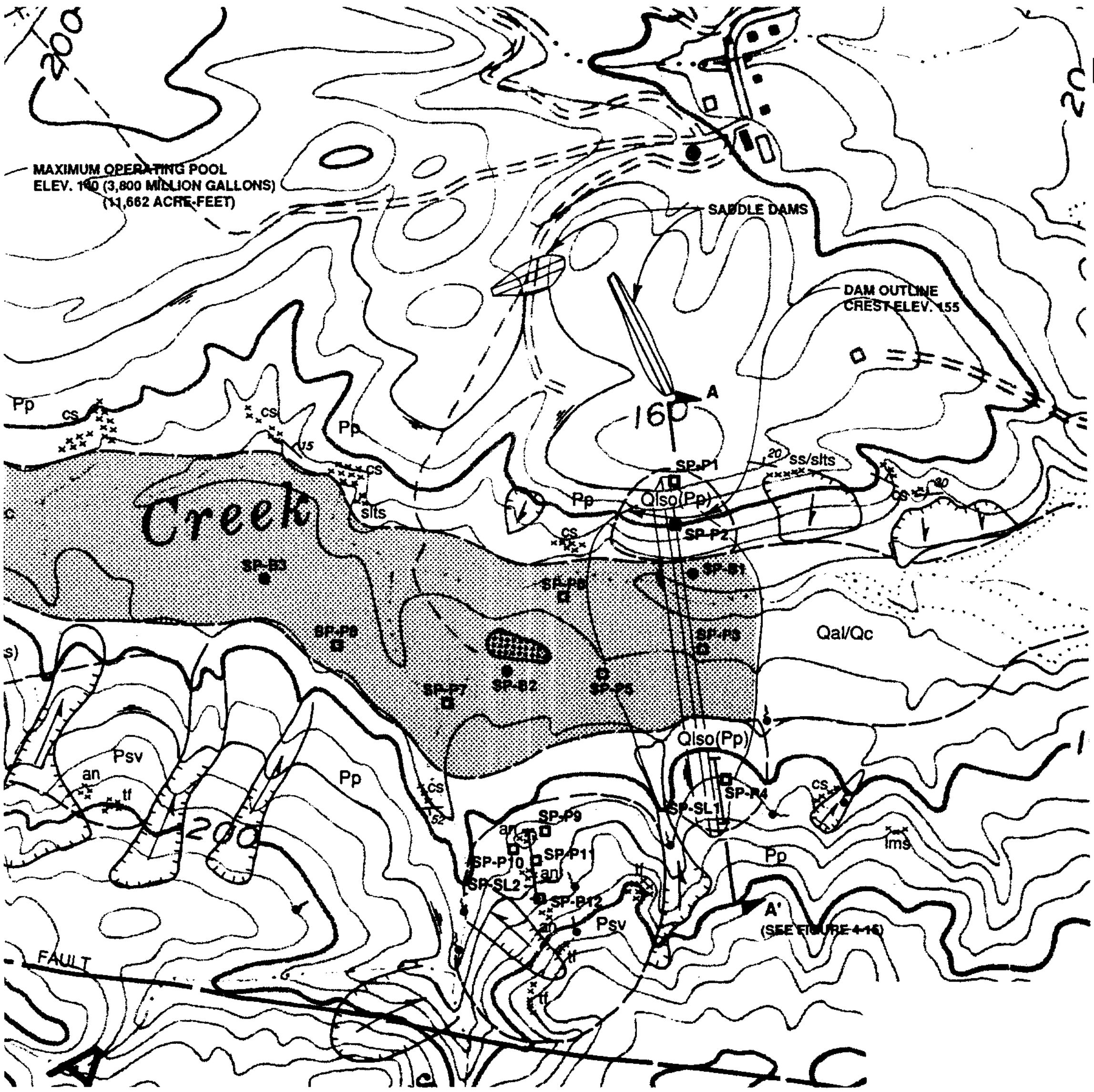
PARSONS ENGINEERING SCIENCE, INC.

UNITS OF PARSONS INFRASTRUCTURE & TECHNOLOGY INC.

PARSONS

Santa Rosa

(G)



LEGEND

EXPLANATION

Qal/Qc	ALLUVIUM/COLLUVIUM: PREDOMINANTLY TO SANDY CLAY; INTERBEDDED WITH CLA THIN LENSES OF SILTY SAND AND GRAVEL WITHIN ALLUVIUM.
Qlso(Psv)	OLD LANDSLIDE DEPOSIT: PROBABLE LA FORMATION MATERIAL IN PARENTHESES.
Pp	PETALUMA FORMATION: PLIOCENE AGE; NON-MARINE; SHOWN WHERE NOTED IN E COMPRISED OF MASSIVE CLAYSTONE (cs) INTERBEDDED SANDSTONE (ss), SILTSTON AND SOME LIMESTONE (lms).
Psv	SONOMA VOLCANICS: PLIOCENE AGE; SH NOTED IN EXPOSURES; INCLUDES ANDESI AGGLOMERATE (ag), RHYOLITIC ASH FLOW

APPROXIMATE GEOLOGIC CONTACT

FAULT, DASHED WHERE UNCERTAIN

20 STRIKE AND DIP OF BEDDING

cs an OUTCROP LOCATION

SPRING

LANDSLIDE

SP-B3 ● EXPLORATION BORING

SP-P8 ◘ TEST PIT

SP-SL2 SEISMIC LINE

A A' LOCATION OF GEOLOGIC SECTION

NOTE: GEOLOGIC FEATURES SHOWN INCLUDING OUTCR SPRINGS AND LANDSLIDES WERE NOTED DURIN RECONNAISSANCE MAPPING ON SPETEMBER 14

IMPERVIOUS BORROW AREA

NOTE: ONLY THE PRIMARY IMPERVIOUS BORROW SOUR SHOWN. SOURCES OF OTHER ON-SITE CONSTRU ALS WITHIN THE RESERVOIR AREA ARE NOT OUT TO THE REPORT FOR EXPLANATION OF ALL BORR

Santa Rosa Subregional Long-Term Wastewater Project

Figur

GEOLOGY of the SEARS POINT RESERVOIR SITE

(3)

LEGEND

EXPLANATION

Symbol	Description
Qal/Qc	ALLUVIUM/COLLUVIUM: PREDOMINANTLY SILTY CLAY TO SANDY CLAY; INTERBEDDED WITH CLAYEY SAND; THIN LENSES OF SILTY SAND AND GRAVELLY SAND WITHIN ALLUVIUM.
Qlso(Psv)	OLD LANDSLIDE DEPOSIT: PROBABLE LANDSLIDE; FORMATION MATERIAL IN PARENTHESES.
Pp	PETALUMA FORMATION: PLIOCENE AGE; MOSTLY NON-MARINE; SHOWN WHERE NOTED IN EXPOSURES; COMPRISED OF MASSIVE CLAYSTONE (cs) WITH INTERBEDDED SANDSTONE (ss), SILTSTONE (slts) AND SOME LIMESTONE (lms).
Psv	SONOMA VOLCANICS: PLIOCENE AGE; SHOWN WHERE NOTED IN EXPOSURES; INCLUDES ANDESITE (an), AGGLOMERATE (ag), RHYOLITIC ASH FLOW TUFF (tf).
	APPROXIMATE GEOLOGIC CONTACT
	FAULT, DASHED WHERE UNCERTAIN
20	STRIKE AND DIP OF BEDDING
cs an	OUTCROP LOCATION
	SPRING
	LANDSLIDE
SP-B3	EXPLORATION BORING
SP-P8	TEST PIT
SP-SL2	SEISMIC LINE
A A'	LOCATION OF GEOLOGIC SECTION

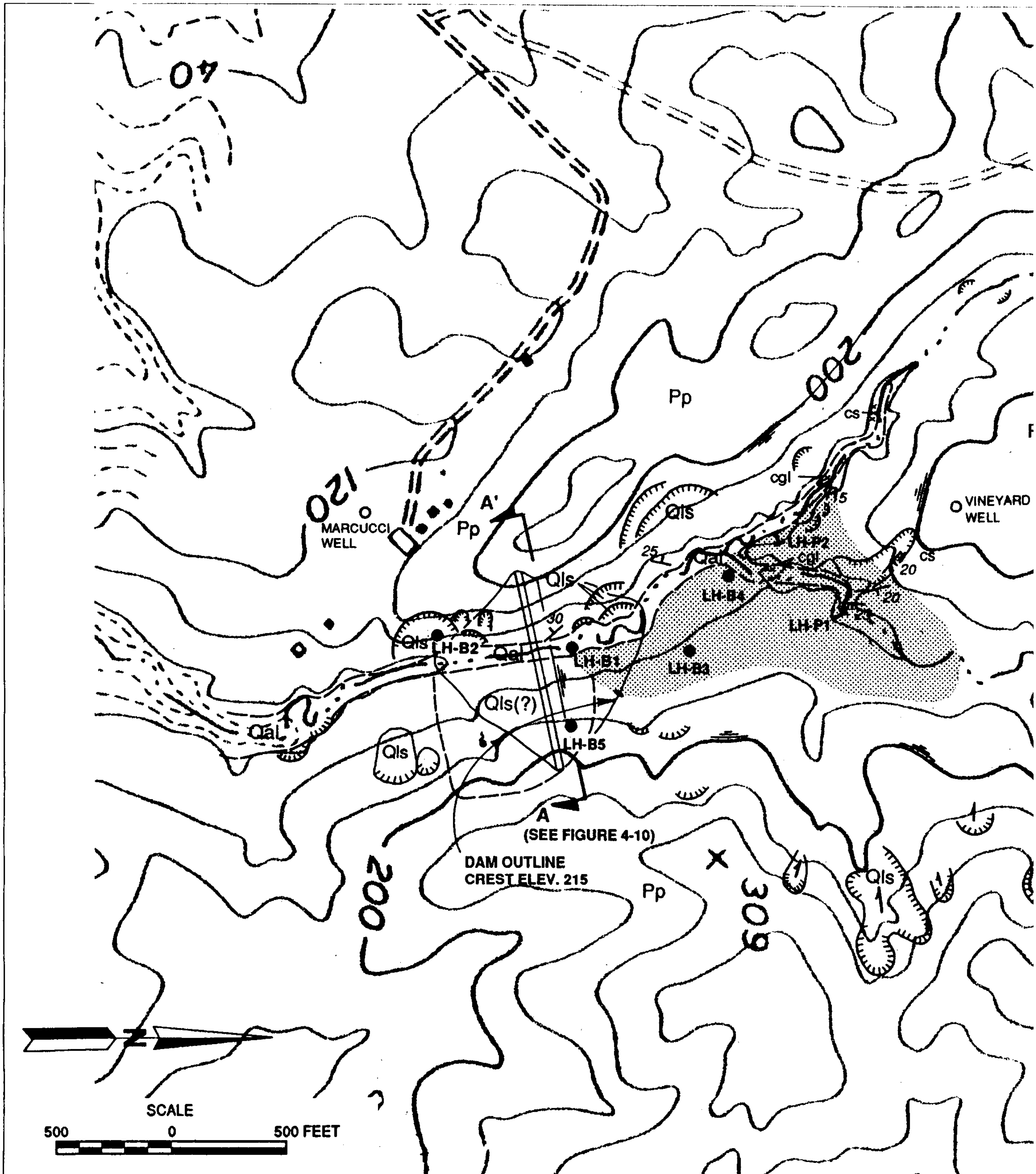
NOTE: GEOLOGIC FEATURES SHOWN INCLUDING OUTCROPS, SPRINGS AND LANDSLIDES WERE NOTED DURING SITE RECONNAISSANCE MAPPING ON SPETEMBER 14-15, 1994.

Symbol	Description
	IMPERVIOUS BORROW AREA

NOTE: ONLY THE PRIMARY IMPERVIOUS BORROW SOURCE AREAS ARE SHOWN. SOURCES OF OTHER ON-SITE CONSTRUCTION MATERIALS WITHIN THE RESERVOIR AREA ARE NOT OUTLINED. REFER TO THE REPORT FOR EXPLANATION OF ALL BORROW SOURCES.

Figure 4.3-4

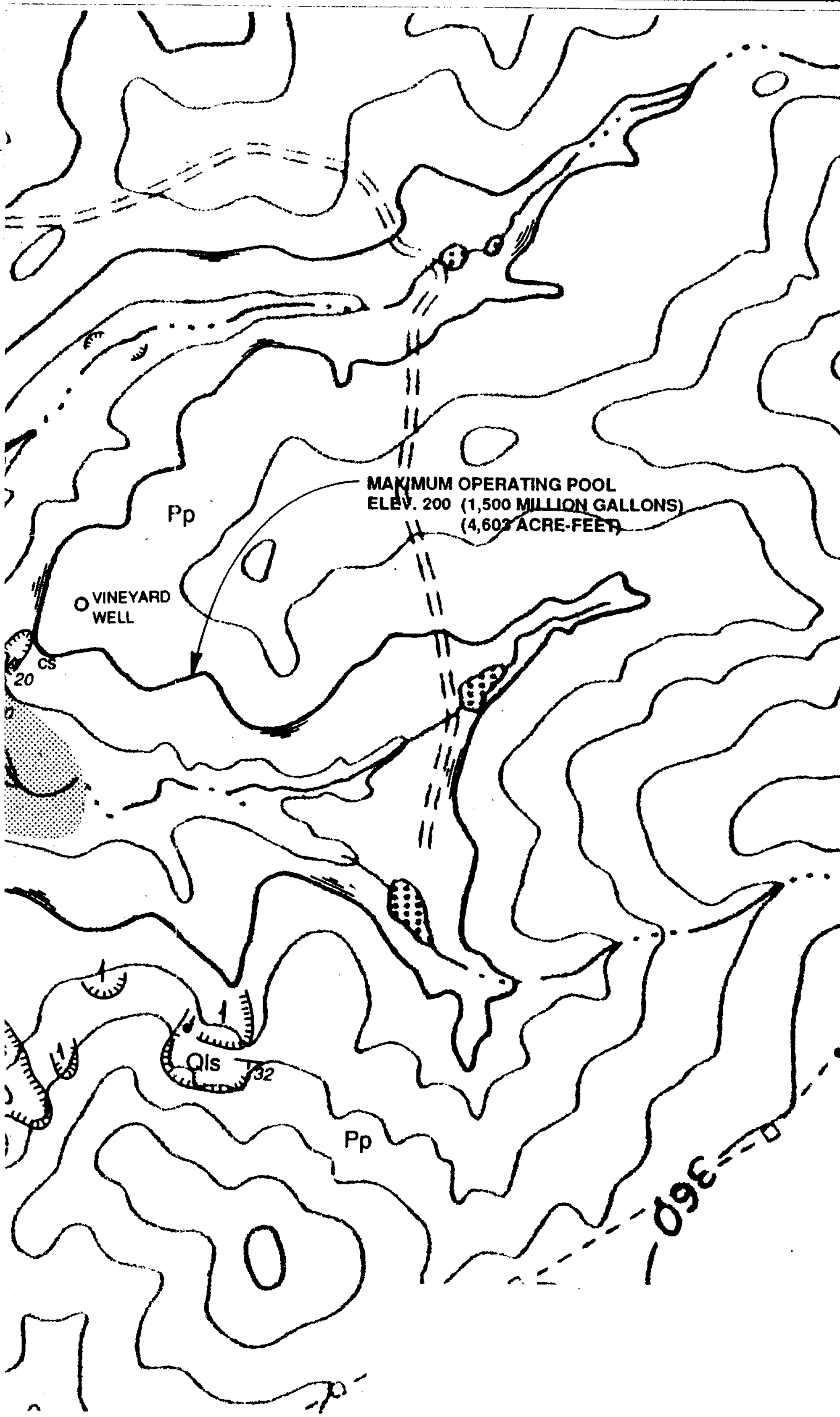
GEOLOGY of the SEARS POINT RESERVOIR SITE



Source: RUST Environment & Infrastructure

HARLAND BARTHOLOMEW & ASSOCIATES, INC.
PARSONS ENGINEERING SCIENCE, INC.
UNITS OF PARSONS INFRASTRUCTURE & TECHNOLOGY INC.
PARSONS

(2)



LEGEND

EXPLANATION

Qal — ALLUVIUM: SANDY CLAY; INTERLAYE CLAYEY SAND AND GRAVELLY CLAY.

Pp — PETALUMA FORMATION: PLIOCENE MOSTLY NON-MARINE; COMPRISED (MASSIVE CLAYSTONE/SILTSTONE (cs WITH LENSES OF FRIABLE SANDSTO AND PEBBLY CONGLOMERATE (cgl).

Qls(?) — POSSIBLE LANDSLIDE DEPOSIT: BASE INTERPRETATION OF EXPLORATION BORING LOG.

APPROXIMATE GEOLOGIC CONTACT

32 — STRIKE AND DIP OF BEDDING

CS ××× cgl — OBSERVED OUTCROP

SPRING

Qls — LANDSLIDE

EXISTING WELL

LH-B5 — EXPLORATION BORING

LH-P2 — CREEK BANK LOGGED AS TEST TRENC

A A' — LOCATION OF GEOLOGIC SECTION

NOTE:
GEOLOGIC FEATURES SHOWN INCLUDING OUTCR(SPRINGS, AND LANDSLIDES WERE NOTED DURING RECONNAISSANCE MAPPING ON SEPTEMBER 21-2

IMPERVIOUS BORROW AREA

NOTE:
ONLY THE PRIMARY IMPERVIOUS BORROW SOU AREAS ARE SHOWN. SOURCES OF OTHER ON-S CONSTRUCTION MATERIALS WITHIN THE RESER AREA ARE NOT OUTLINED. REFER TO THE REPC FOR EXPLANATION OF ALL BORROW SOURCES.

anta Rosa
Subregional Long-Term
Wastewater Project

GEOLOGY of the
LAKEVILLE HILLSIDE RESERVOIR

Figur

3

LEGEND

EXPLANATION

Qal — ALLUVIUM: SANDY CLAY; INTERLAYERED CLAYEY SAND AND GRAVELLY CLAY.

Pp — PETALUMA FORMATION: PLIOCENE AGE; MOSTLY NON-MARINE; COMPRISED OF MASSIVE CLAYSTONE/SILTSTONE (cs), WITH LENSES OF FRIABLE SANDSTONE (ss) AND PEBBLY CONGLOMERATE (cgl).

Qls(?) — POSSIBLE LANDSLIDE DEPOSIT: BASED ON INTERPRETATION OF EXPLORATION BORING LOG.

APPROXIMATE GEOLOGIC CONTACT

32 STRIKE AND DIP OF BEDDING

cs cgl OBSERVED OUTCROP

SPRING

Qls LANDSLIDE

EXISTING WELL

LH-B5 EXPLORATION BORING

LH-P2 CREEK BANK LOGGED AS TEST TRENCH

A A' LOCATION OF GEOLOGIC SECTION

NOTE:
GEOLOGIC FEATURES SHOWN INCLUDING OUTCROPS, SPRINGS, AND LANDSLIDES WERE NOTED DURING SITE RECONNAISSANCE MAPPING ON SEPTEMBER 21-22, 1994.

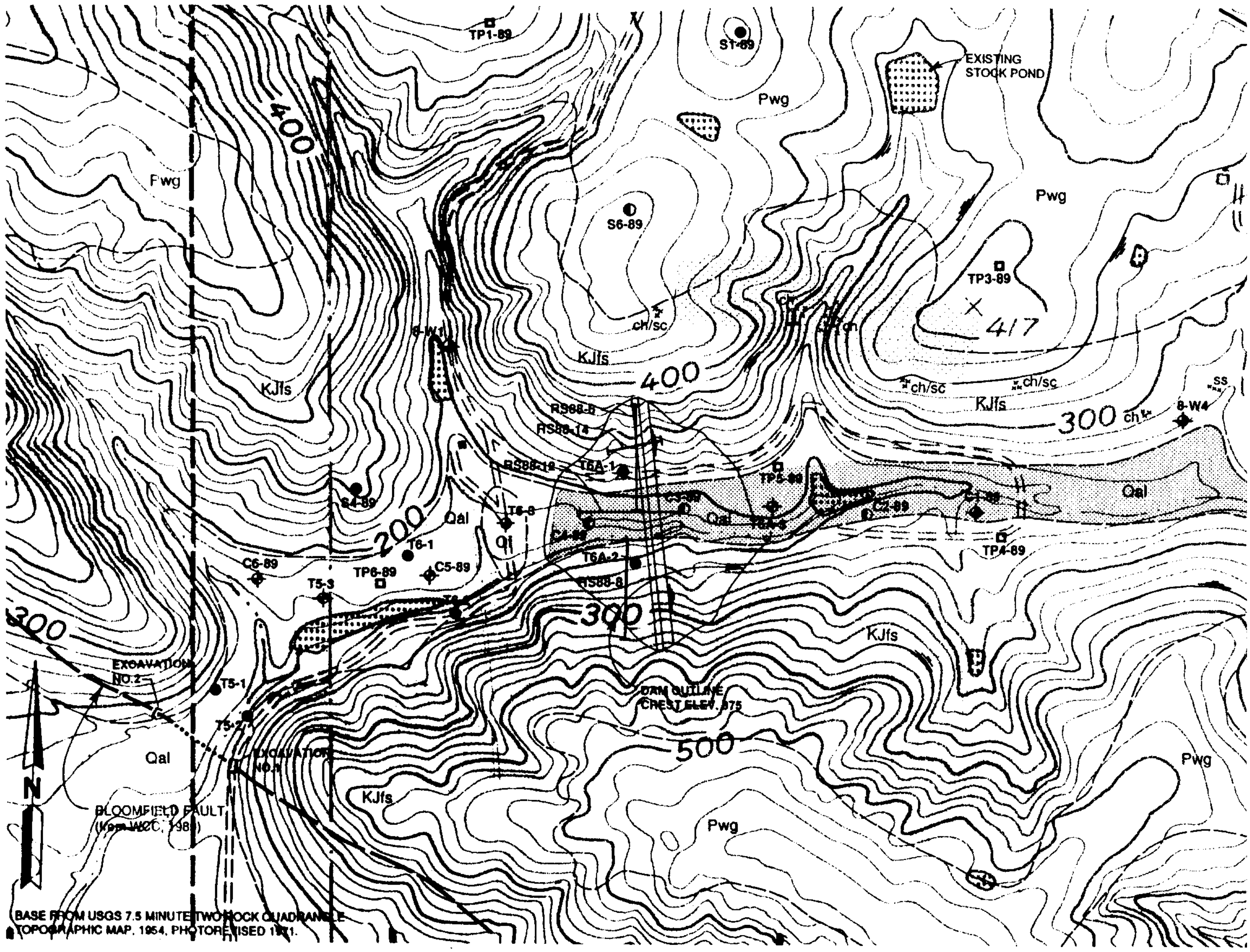
IMPERVIOUS BORROW AREA

NOTE:
ONLY THE PRIMARY IMPERVIOUS BORROW SOURCE AREAS ARE SHOWN. SOURCES OF OTHER ON-SITE CONSTRUCTION MATERIALS WITHIN THE RESERVOIR AREA ARE NOT OUTLINED. REFER TO THE REPORT FOR EXPLANATION OF ALL BORROW SOURCES.

GEOLOGY of the LAKEVILLE HILLSIDE RESERVOIR SITE

Figure 4.3-5

(1)

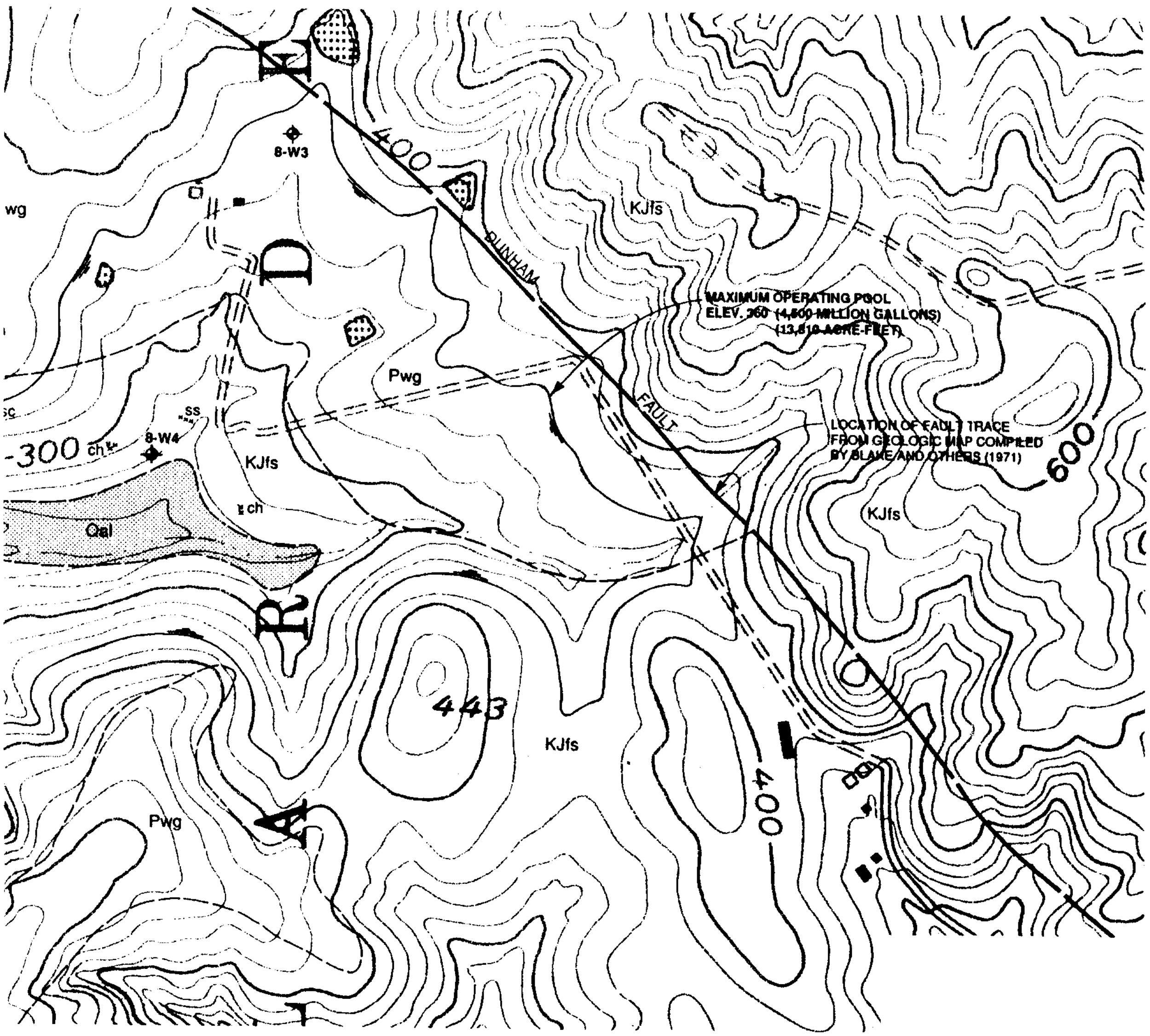


SCALE
500 0 500 FEET

Source: RUST Environment & Infrastructure

HARLAND BARTHOLOMEW & ASSOCIATES, INC.
PARSONS ENGINEERING SCIENCE, INC.
UNITS OF PARSONS INFRASTRUCTURE & TECHNOLOGY INC.
PARSONS

Santa



LEGEND

EXPLANATION

Qf	FILL: MIXED CLAY, SILT, SAND, (WITH EARTH DIKES.
Qal	ALLUVIUM AND COLLUVIUM: SAND AND GRAVEL.
Pwg	WILSON GROVE FORMATION FORMATION): SANDY SILTSTO MASSIVE; FINE GRAINED; SOFT
KJfs	FRANCISCAN COMPLEX: MEL CONSISTING OF SHEARED, CR FRACTURED SANDSTONE; INC MASSES OF CHERT (ch), SILIC GREENSTONE AND GRAYWAC
	APPROXIMATE GEOLOGIC CONT
	FAULT, DASHED WHERE UNCER WHERE CONCEALED
ch ××× ××sc	OBSERVED OUTCROP

NOTE: GEOLOGIC FEATURES SHOWN INCLUDIN NOTED DURING SITE RECONNAISSANCE OCTOBER 21, 1994.

PREVIOUS EXPLORATION BY WOODWARD-CLYDE CONSULTANTS (W

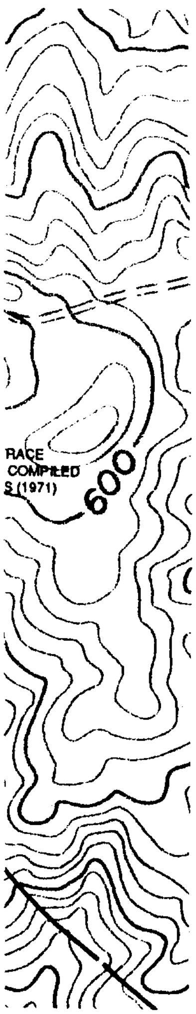
T6A-1 ●	CORE HOLE
C3-89 ◐	AUGER BORING
T6A-3 8-W4	AUGER BORING WITH PIEZOMETI
TP4-89 ◘	TEST PIT
RS88-8	SEISMIC LINE
	IMPERVIOUS BORROW AREA
	POTENTIAL HARD ROCK BORR (OUTSIDE RESERVOIR - NOT AS DESIGN)

NOTE: ONLY THE PRIMARY IMPERVIOUS BORROW AND POTENTIAL HARD ROCK SOURCE ARE RESERVOIR AREA ARE SHOWN. SOURCES CONSTRUCTION MATERIALS WITHIN THE F ARE NOT OUTLINED. REFER TO THE REPO NATION OF ALL BORROW SOURCES.

Santa Rosa Subregional Long-Term Wastewater Project

GEOLOGY of the TWO ROCK RESERVOIR SITE

Fig



LEGEND

EXPLANATION

Qf	FILL: MIXED CLAY, SILT, SAND, GRAVEL ASSOCIATED WITH EARTH DIKES.
Qal	ALLUVIUM AND COLLUVIUM: MIXED CLAY, SILT, SAND AND GRAVEL.
Pwg	WILSON GROVE FORMATION (FORMERLY MERCED FORMATION): SANDY SILTSTONE, SILTSTONE; MASSIVE; FINE GRAINED; SOFT.
KJfs	FRANCISCAN COMPLEX: MELANGE MATERIAL CONSISTING OF SHEARED, CRUSHED SHALE AND FRACTURED SANDSTONE; INCLUDES RESISTANT MASSES OF CHERT (ch), SILICA CARBONATE (sc), GREENSTONE AND GRAYWACKE SANDSTONE (ss).

APPROXIMATE GEOLOGIC CONTACT

FAULT, DASHED WHERE UNCERTAIN, DOTTED WHERE CONCEALED

ch ××× ×× sc OBSERVED OUTCROP

NOTE: GEOLOGIC FEATURES SHOWN INCLUDING OUTCROPS WERE NOTED DURING SITE RECONNAISSANCE MAPPING ON OCTOBER 21, 1994.

PREVIOUS EXPLORATION BY WOODWARD-CLYDE CONSULTANTS (WCC):

T6A-1 ●	CORE HOLE
C3-89 ◐	AUGER BORING
T6A-3 8-W4	AUGER BORING WITH PIEZOMETER
TP4-89 ◘	TEST PIT
RS88-8	SEISMIC LINE

IMPERVIOUS BORROW AREA

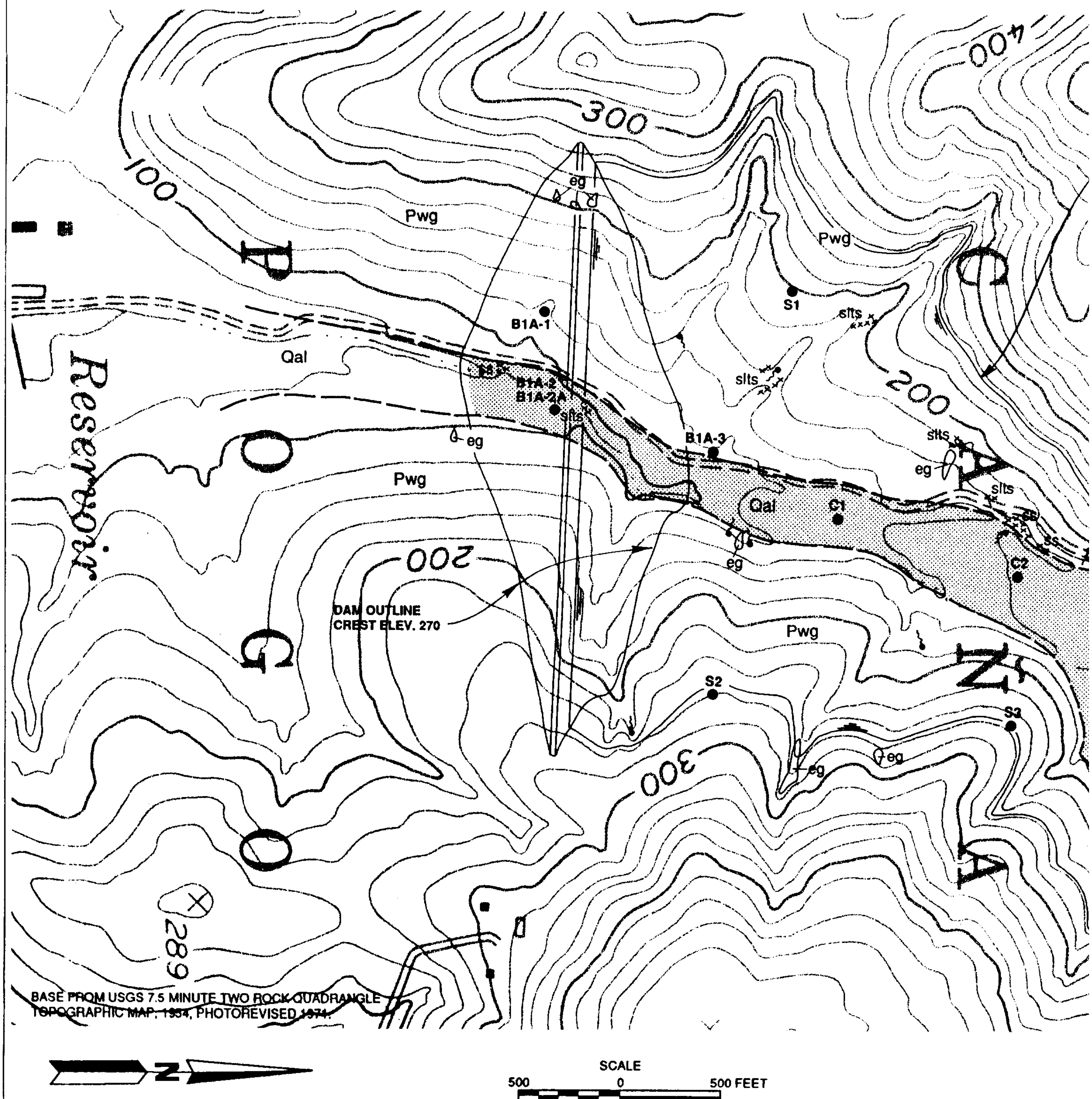
POTENTIAL HARD ROCK BORROW AREA (OUTSIDE RESERVOIR - NOT ASSUMED FOR DESIGN)

NOTE: ONLY THE PRIMARY IMPERVIOUS BORROW SOURCE AREAS AND POTENTIAL HARD ROCK SOURCE AREA OUTSIDE THE RESERVOIR AREA ARE SHOWN. SOURCES OF OTHER ON-SITE CONSTRUCTION MATERIALS WITHIN THE RESERVOIR AREA ARE NOT OUTLINED. REFER TO THE REPORT FOR EXPLANATION OF ALL BORROW SOURCES.

GEOLOGY of the TWO ROCK RESERVOIR SITE

Figure 4.3-6

(1)

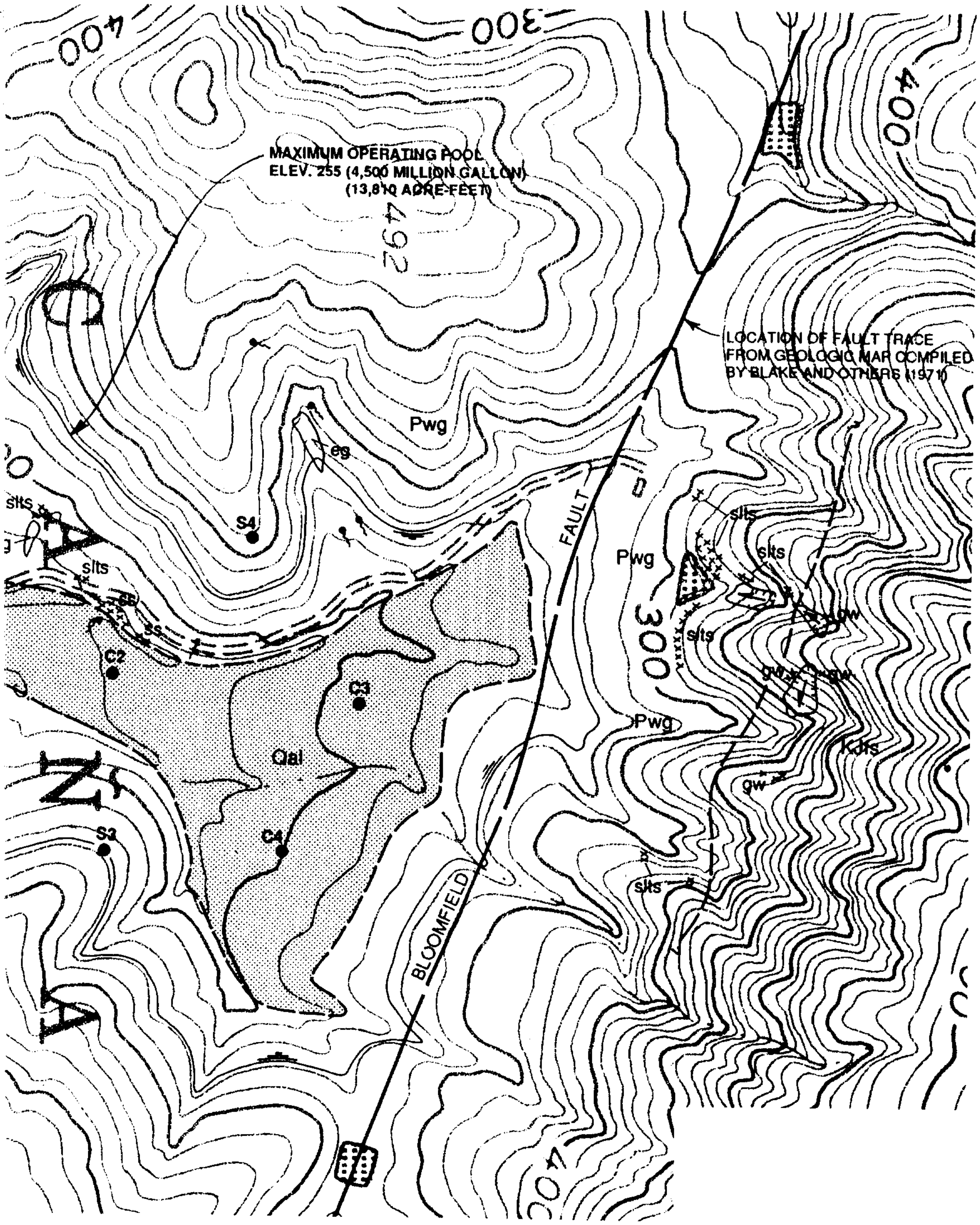


Source: RUST Environment & Infrastructure

HARLAND BARTHOLOMEW & ASSOCIATES, INC.
PARSONS ENGINEERING SCIENCE, INC.
UNITS OF PARSONS INFRASTRUCTURE & TECHNOLOGY INC.

PARSONS

Santa Rosa



LEGEND

Qal — ALLUVIUM: SANDY CLAYS , SILTY SA SANDY SILTS.

Pwg — WILSON GROVE FORMATION (FOR MERCED FORMATION: SANDY SILTS FINE SANDSTONE, OCCASIONAL CL BEDDING NOT DISCERNABLE; SOFT HARDNESS; STRONG; APPEARS TIG

KJfs — FRANCISCAN COMPLEX: INCLUDES GRAYWACKE, SHEARED SHALE AND SILTSTONE.

APPROXIMATE GEOLOGIC CONTACT

FAULT, DASHED WHERE UNCERTAIN

OBSERVED OUTCROP: WILSON GROV SILTSTONE (slts), FINE SANDSTONE (ss) FRANCISCAN COMPLEX GRAYWACKE (

SPRING

eg — EROSION GULLY OR SCAR

LANDSLIDE

NOTE: GEOLOGIC FEATURES SHOWN INCLUDING OUTCR EROSION GULLIES, AND LANDSLIDES WERE NOTED RECONNAISSANCE MAPPING ON OCTOBER 6-7, 19

PREVIOUS EXPLORATION BY WOODWARD-CLYDE CONSULTANTS (WCC):

B1A-1 ● EXPLORATION BORING (1988)

S1, C1 ● EXPLORATION BORING (1989)

IMPERVIOUS BORROW AREA

NOTE: ONLY THE PRIMARY IMPERVIOUS BORROW SOUR ARE SHOWN. SOURCES OF OTHER ON-SITE CON MATERIALS WITHIN THE RESERVOIR AREA ARE N LINED. REFER TO THE REPORT FOR EXPLANATIC BORROW SOURCES.

GEOLOGY of the BLOOMFIELD RESERVOIR SITE

3

LEGEND

Qal	ALLUVIUM: SANDY CLAYS , SILTY SANDS, SANDY SILTS.
Pwg	WILSON GROVE FORMATION (FORMERLY MERCED FORMATION: SANDY SILTSTONE, FINE SANDSTONE, OCCASIONAL CLAYSTONE; BEDDING NOT DISCERNABLE; SOFT IN HARDNESS; STRONG; APPEARS TIGHT.
KJfs	FRANCISCAN COMPLEX: INCLUDES GRAYWACKE, SHEARED SHALE AND SILTSTONE.

APPROXIMATE GEOLOGIC CONTACT

FAULT, DASHED WHERE UNCERTAIN

OBSERVED OUTCROP: WILSON GROVE FORMATION SILTSTONE (slts), FINE SANDSTONE (ss); FRANCISCAN COMPLEX GRAYWACKE (gw)

SPRING

eg EROSION GULLY OR SCAR

LANDSLIDE

NOTE: GEOLOGIC FEATURES SHOWN INCLUDING OUTCROPS, SPRINGS, EROSION GULLIES, AND LANDSLIDES WERE NOTED DURING SITE RECONNAISSANCE MAPPING ON OCTOBER 6-7, 1994.

PREVIOUS EXPLORATION BY WOODWARD-CLYDE CONSULTANTS (WCC):

B1A-1 ● EXPLORATION BORING (1988)

S1, C1 ● EXPLORATION BORING (1989)

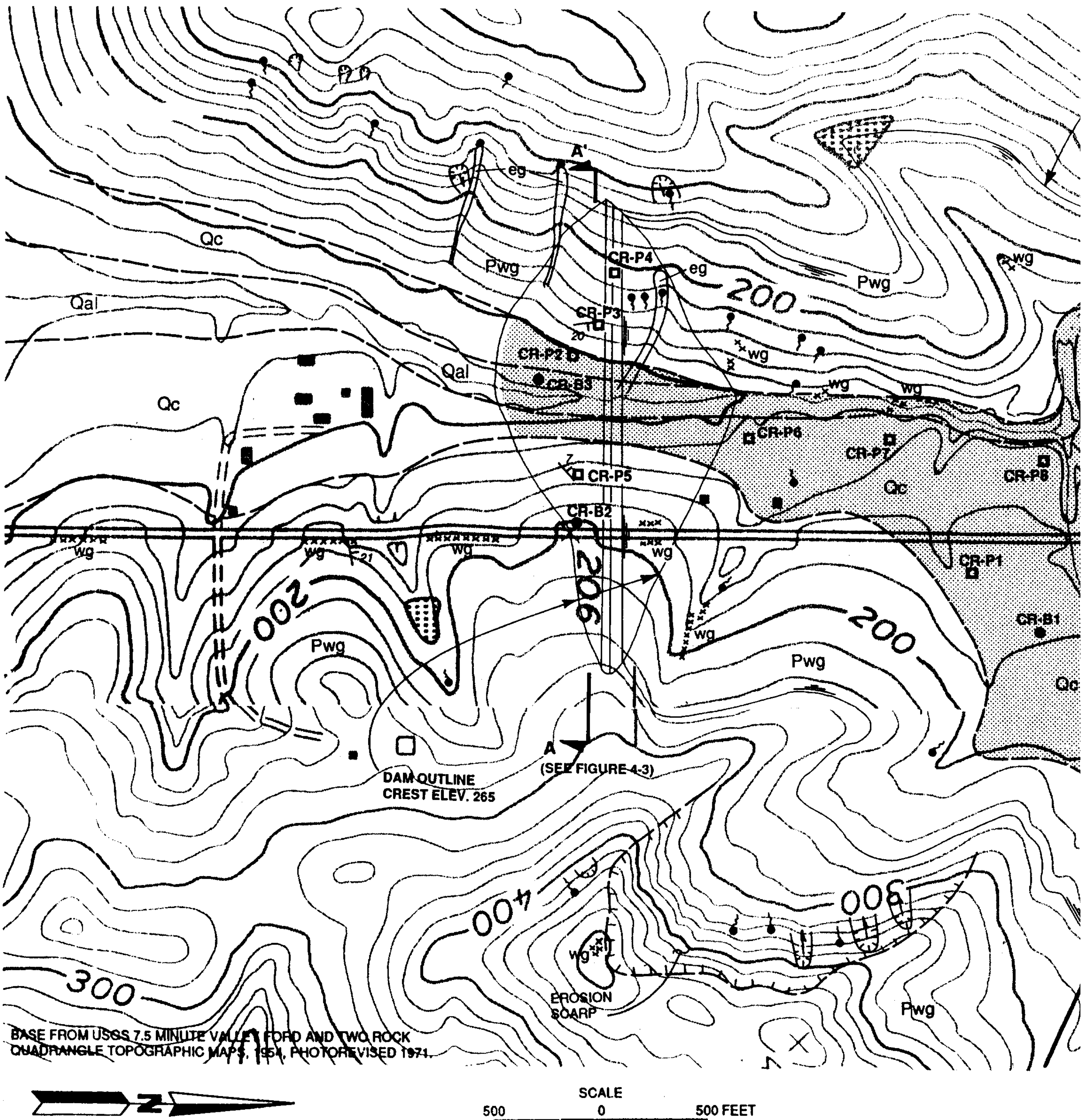
IMPERVIOUS BORROW AREA

NOTE: ONLY THE PRIMARY IMPERVIOUS BORROW SOURCE AREAS ARE SHOWN. SOURCES OF OTHER ON-SITE CONSTRUCTION MATERIALS WITHIN THE RESERVOIR AREA ARE NOT OUTLINED. REFER TO THE REPORT FOR EXPLANATION OF ALL BORROW SOURCES.

GEOLOGY of the BLOOMFIELD RESERVOIR SITE

Figure 4.3-7

(1)



Source: RUST Environment & Infrastructure

HARLAND BARTHOLOMEW & ASSOCIATES, INC.

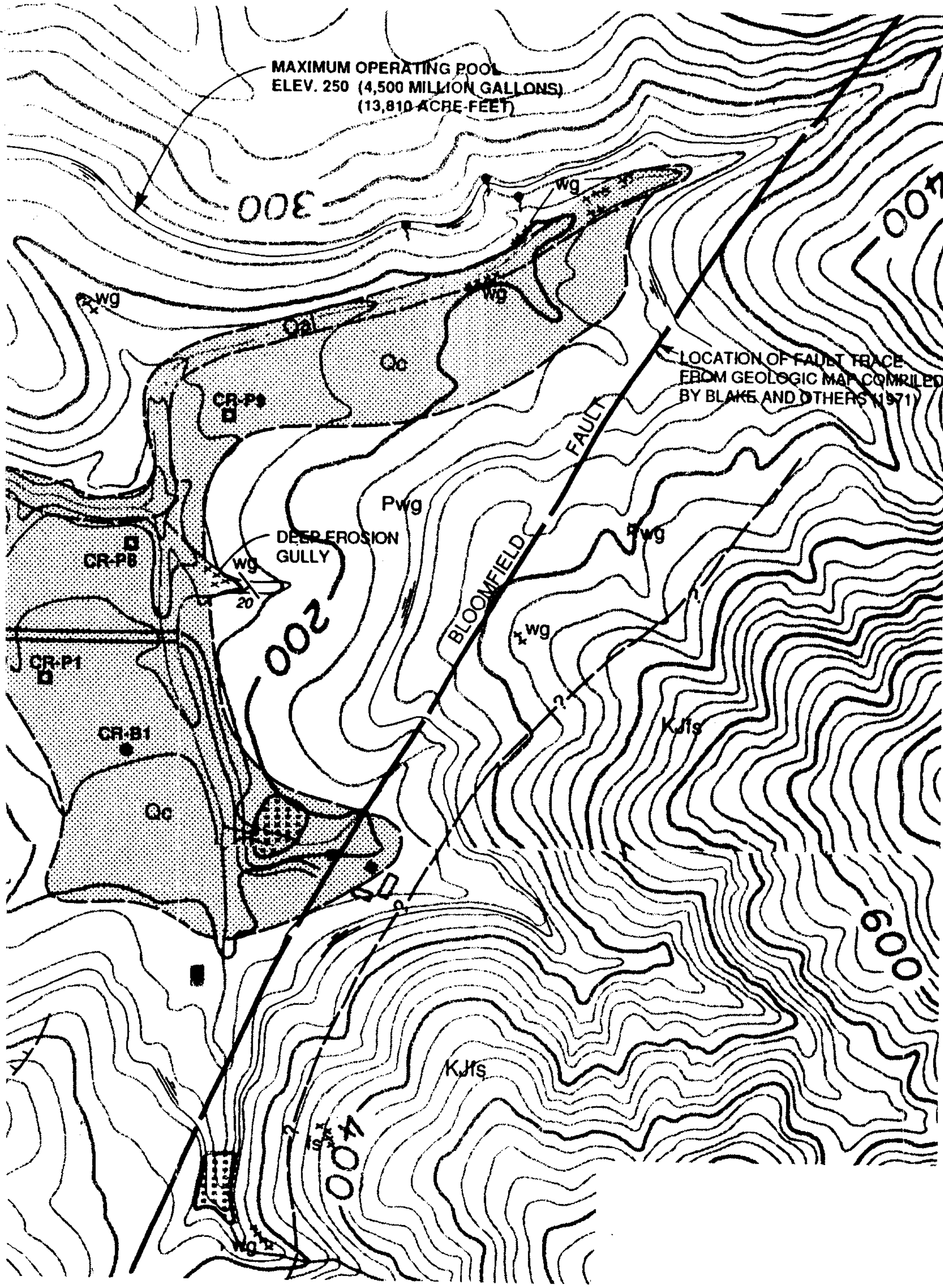
PARSONS ENGINEERING SCIENCE, INC.

UNITS OF PARSONS INFRASTRUCTURE & TECHNOLOGY INC.

PARSONS

Santa Rosa

(2)



LEGEND

Qal/Qc — ALLUVIUM/COLLUVIUM: PREDOMINANTL CLAY; LOCALLY CLAYEY SAND; THIN INTE OF SILTY SAND TO GRAVELLY SAND; RE MORE GRANULAR SILTY SAND AND GRAV SAND ALONG ACTIVE STREAM CHANNEL.

Pwg — WILSON GROVE FORMATION (FORMERL FORMATION): SANDY SILTSTONE, SILTY S STONE AND SANDY CLAYSTONE; POSSIB INTERBEDS OF COARSER SANDSTONE; M WEAKLY CEMENTED; FRIABLE.

KJfs — FRANCISCAN COMPLEX: MELANGE MAT CONSISTING OF CHAOTIC MIXTURE OF R UNSHEARED SANDSTONE, GREENSTONE AND SILICA CARBONATE IN A MATRIX OF AND CRUSHED SHALE AND SILTSTONE.

APPROXIMATE GEOLOGIC CONTACT

FAULT, DASHED WHERE UNCERTAIN

20 — STRIKE AND DIP OF BEDDING

OBSERVED OUTCROP: WILSON GROVE FORMATION SILTSTONE (wg); FRANCISCAN COMPLEX SANDSTONE (fs).

SEEP /SPRING

eg — EROSION GULLY

LANDSLIDE

CR-B3 ● EXPLORATION BORING

CR-P9 ◻ TEST PIT

A — A' LOCATION OF GEOLOGIC SECTION

NOTE: GEOLOGIC FEATURES SHOWN INCLUDING OUTC SPRINGS, EROSION GULLIES, AND LANDSLIDES NOTED DURING SITE RECONNAISSANCE MAPPIN SEPTEMBER 29-30, 1994.

IMPERVIOUS BORROW AREA

NOTE: ONLY THE PRIMARY IMPERVIOUS BORROW SOURC ARE SHOWN. SOURCES OF OTHER ON-SITE CONST MATERIALS WITHIN THE RESERVOIR AREA ARE NO LINED. REFER TO THE REPORT FOR EXPLANATION BORROW SOURCES.

3

LEGEND

Qal/Qc — ALLUVIUM/COLLUVIUM: PREDOMINANTLY SANDY CLAY; LOCALLY CLAYEY SAND; THIN INTERBEDS OF SILTY SAND TO GRAVELLY SAND; RELATIVELY MORE GRANULAR SILTY SAND AND GRAVELLY SAND ALONG ACTIVE STREAM CHANNEL.

Pwg — WILSON GROVE FORMATION (FORMERLY MERCED FORMATION): SANDY SILTSTONE, SILTY SANDSTONE AND SANDY CLAYSTONE; POSSIBLY INTERBEDS OF COARSER SANDSTONE; MASSIVE; WEAKLY CEMENTED; FRIABLE.

KJfs — FRANCISCAN COMPLEX: MELANGE MATERIAL CONSISTING OF CHAOTIC MIXTURE OF RELATIVELY UNSHEARED SANDSTONE, GREENSTONE, CHERT, AND SILICA CARBONATE IN A MATRIX OF SHEARED AND CRUSHED SHALE AND SILTSTONE.

APPROXIMATE GEOLOGIC CONTACT

FAULT, DASHED WHERE UNCERTAIN

20 STRIKE AND DIP OF BEDDING

OBSERVED OUTCROP: WILSON GROVE FORMATION SILTSTONE (wg); FRANCISCAN COMPLEX SANDSTONE (fs).

SEEP /SPRING

eg EROSION GULLY

LANDSLIDE

CR-B3 EXPLORATION BORING

CR-P9 TEST PIT

A A' LOCATION OF GEOLOGIC SECTION

NOTE: GEOLOGIC FEATURES SHOWN INCLUDING OUTCROPS, SPRINGS, EROSION GULLIES, AND LANDSLIDES WERE NOTED DURING SITE RECONNAISSANCE MAPPING ON SEPTEMBER 29-30, 1994.

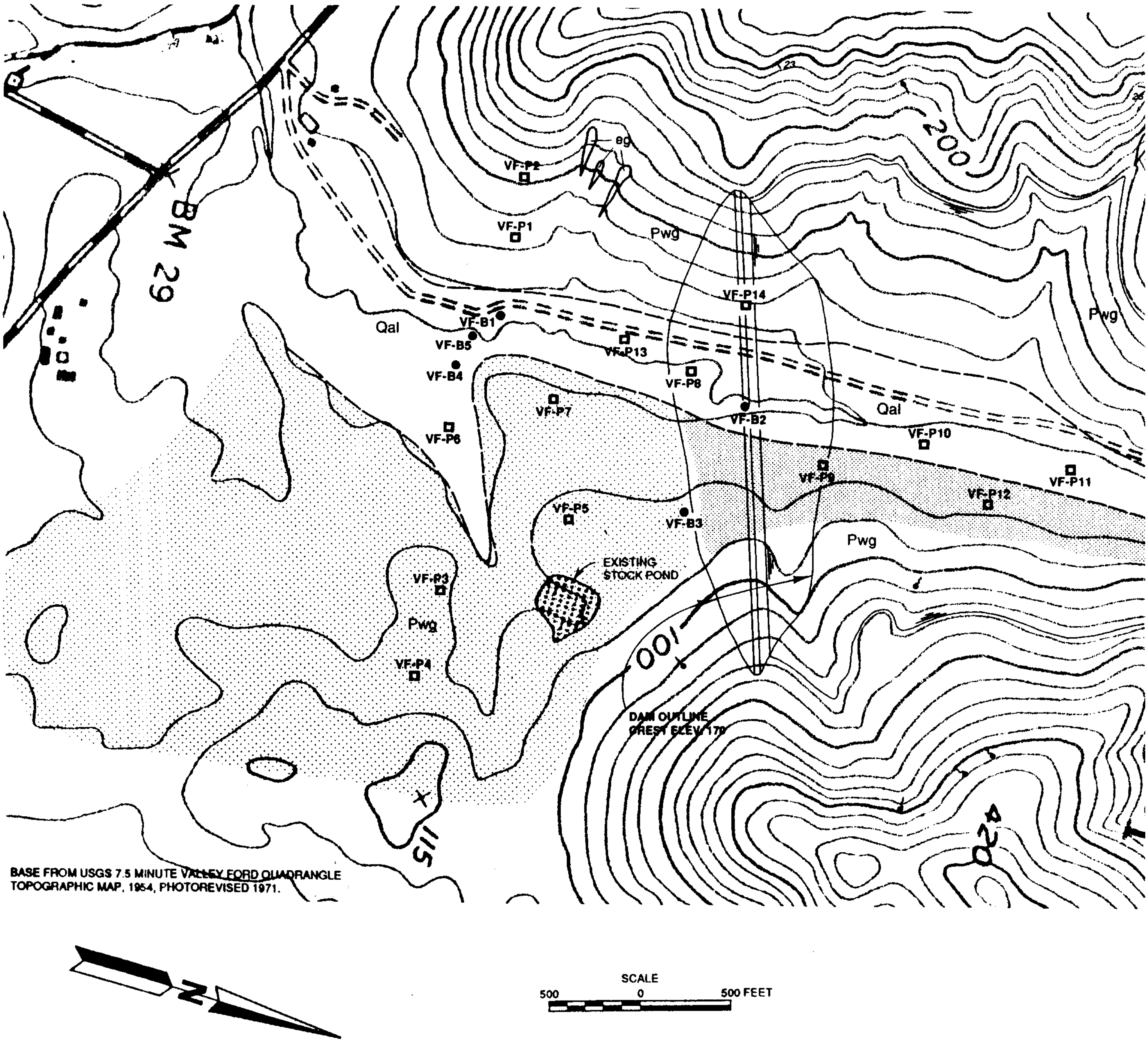
IMPERVIOUS BORROW AREA

NOTE: ONLY THE PRIMARY IMPERVIOUS BORROW SOURCE AREAS ARE SHOWN. SOURCES OF OTHER ON-SITE CONSTRUCTION MATERIALS WITHIN THE RESERVOIR AREA ARE NOT OUTLINED. REFER TO THE REPORT FOR EXPLANATION OF ALL BORROW SOURCES.

GEOLOGY of the CARROLL ROAD RESERVOIR SITE

Figure 4.3-8

(1)



Source: RUST Environment & Infrastructure

HARLAND BARTHOLOMEW & ASSOCIATES, INC.

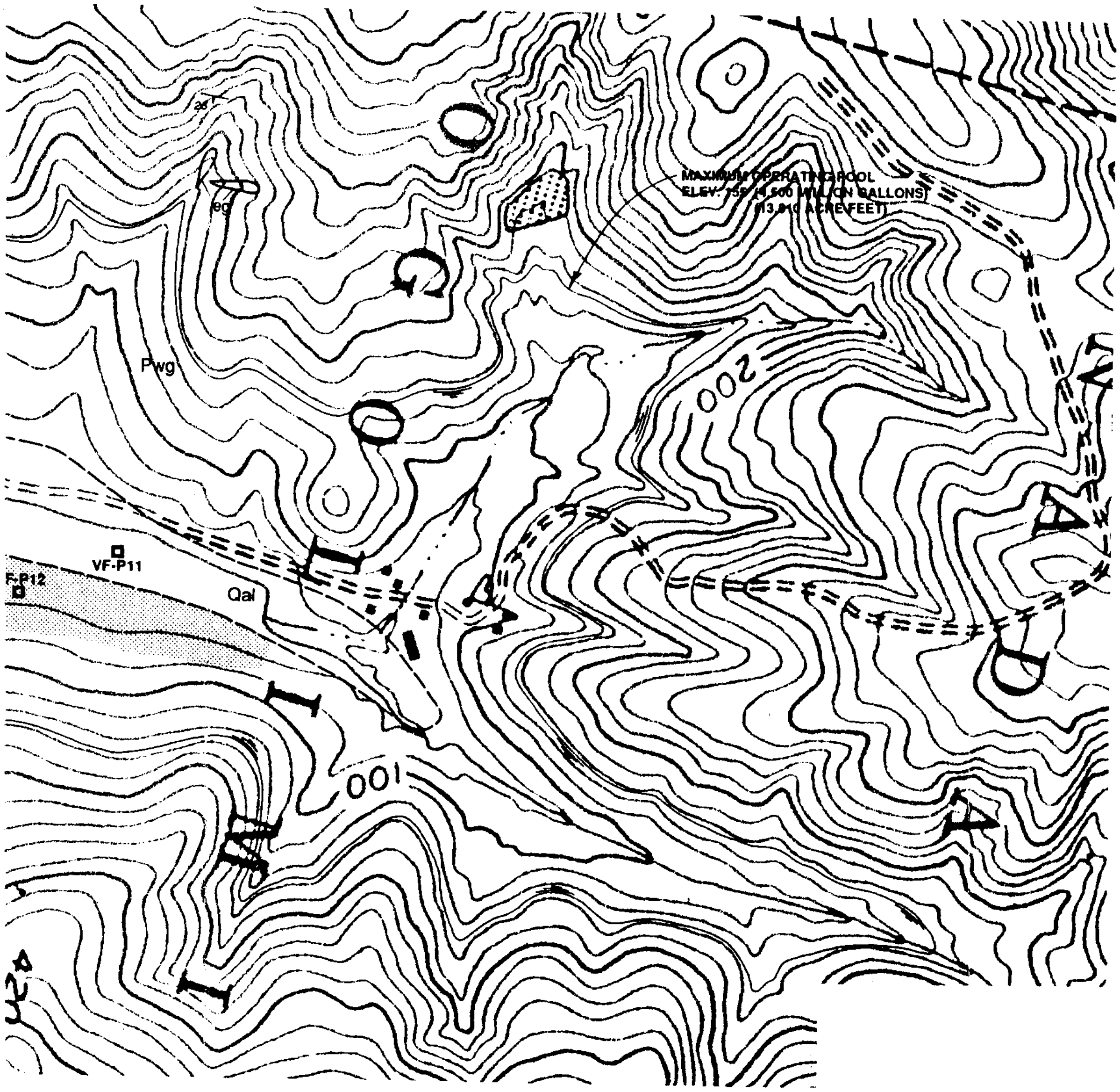
PARSONS ENGINEERING SCIENCE, INC.

UNITS OF PARSONS INFRASTRUCTURE & TECHNOLOGY INC.

PARSONS

Santa Rosa

(2)



LEGEND

Qal ALLUVIUM: CLAYEY SAND; SANDY CL
INTERLAYERED; LOCATED IN VALLEY
MAXIMUM THICKNESS ON THE ORDE
IN PROPOSED RESERVOIR AREA.

Pwg WILSON GROVE FORMATION (FORM
FORMATION): RARE OUTCROPS; SAN
SILTSTONE; MASSIVE; BEDDING NOT
GENERALLY SUBHORIZONTAL TO SL
DIP TO NORTHEAST; SOFT IN HARDN
APPEARS TIGHT; IN PROPOSED RESE
OVERLAIN BY 0 TO 5 FEET OF CLAYE
SANDY CLAY TOPSOIL OR COLLUVIU

APPROXIMATE GEOLOGIC CONTACT

23 STRIKE AND DIP OF BEDDING

SPRING

eg EROSION GULLY

VF-B5 ● EXPLORATION BORING

VF-P12 ☐ TEST PIT

NOTE: GEOLOGIC FEATURES SHOWN INCLUDING SP
EROSION GULLIES WERE NOTED DURING SITE
SANCE MAPPING ON SEPTEMBER 27-28, 1994.

IMPERVIOUS BORROW AREA

POTENTIAL ADDITIONAL IMPERVI
BORROW AREA (OUTSIDE RESER
AREA - NOT ASSUMED FOR DESIG

NOTE: ONLY THE PRIMARY IMPERVIOUS BORROW
AREAS ARE SHOWN. SOURCES OF OTHER
CONSTRUCTION MATERIALS WITHIN THE R
AREA ARE NOT OUTLINED. REFER TO THE
FOR EXPLANATION OF ALL BORROW SOUR

(3)

LEGEND

Qal — ALLUVIUM: CLAYEY SAND; SANDY CLAY; SILTY SAND; INTERLAYERED; LOCATED IN VALLEY FLOOR; MAXIMUM THICKNESS ON THE ORDER OF 16 FEET IN PROPOSED RESERVOIR AREA.

Pwg — WILSON GROVE FORMATION (FORMERLY MERCED FORMATION): RARE OUTCROPS; SANDY SILTSTONE/ SILTSTONE; MASSIVE; BEDDING NOT DISCERNABLE; GENERALLY SUBHORIZONTAL TO SLIGHT/MODERATE DIP TO NORTHEAST; SOFT IN HARDNESS; STRONG; APPEARS TIGHT; IN PROPOSED RESERVOIR AREA, OVERLAIN BY 0 TO 5 FEET OF CLAYEY SAND TO SANDY CLAY TOPSOIL OR COLLUVIUM.

— — — APPROXIMATE GEOLOGIC CONTACT

23 STRIKE AND DIP OF BEDDING

SPRING

eg EROSION GULLY

VF-B5 ● EXPLORATION BORING

VF-P12 ◘ TEST PIT

NOTE: GEOLOGIC FEATURES SHOWN INCLUDING SPRINGS AND EROSION GULLIES WERE NOTED DURING SITE RECONNAISSANCE MAPPING ON SEPTEMBER 27-28, 1994.

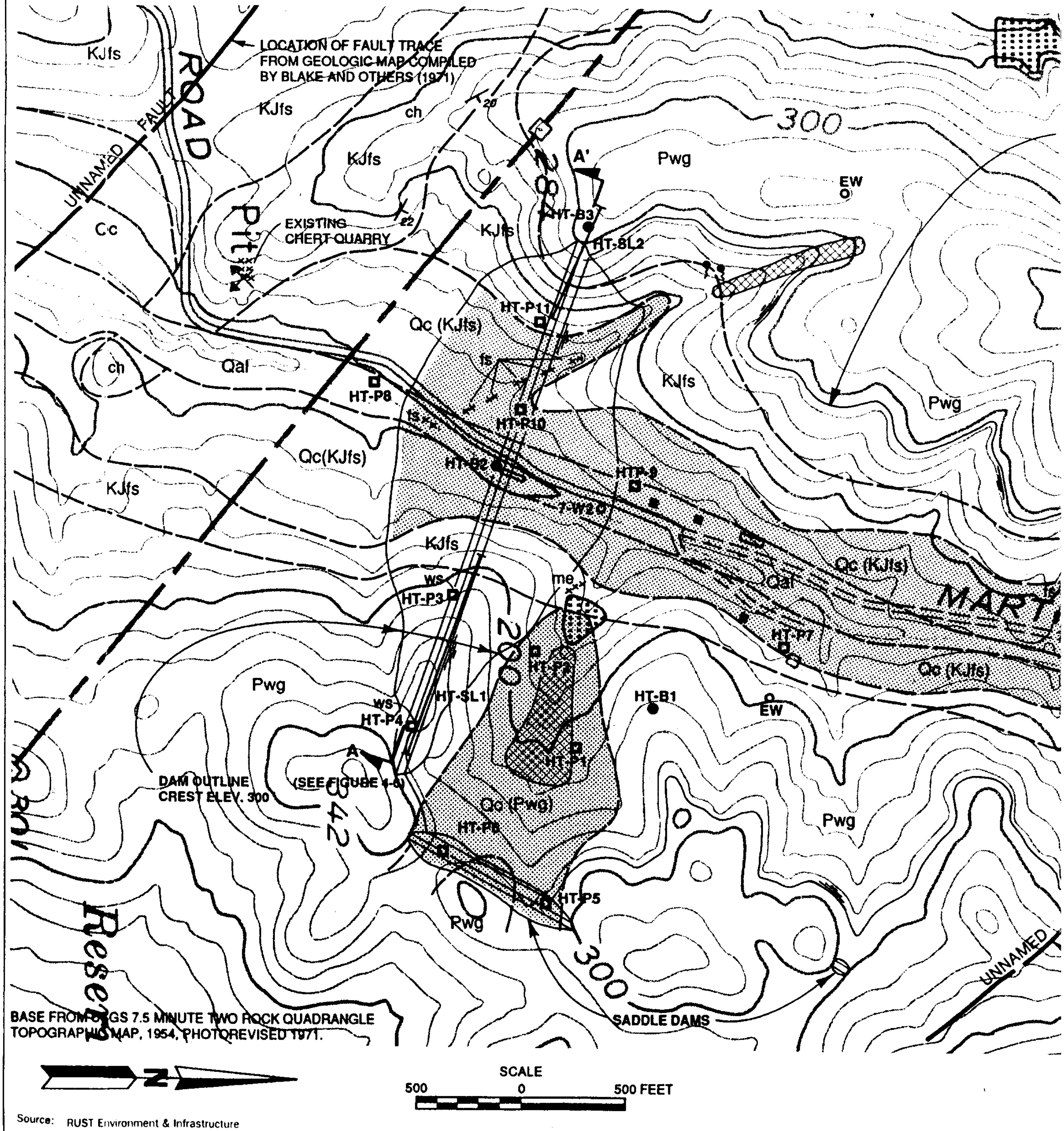
IMPERVIOUS BORROW AREA

POTENTIAL ADDITIONAL IMPERVIOUS BORROW AREA (OUTSIDE RESERVOIR AREA - NOT ASSUMED FOR DESIGN)

NOTE: ONLY THE PRIMARY IMPERVIOUS BORROW SOURCE AREAS ARE SHOWN. SOURCES OF OTHER ON-SITE CONSTRUCTION MATERIALS WITHIN THE RESERVOIR AREA ARE NOT OUTLINED. REFER TO THE REPORT FOR EXPLANATION OF ALL BORROW SOURCES.

GEOLOGY of the VALLEY FORD RESERVOIR SITE

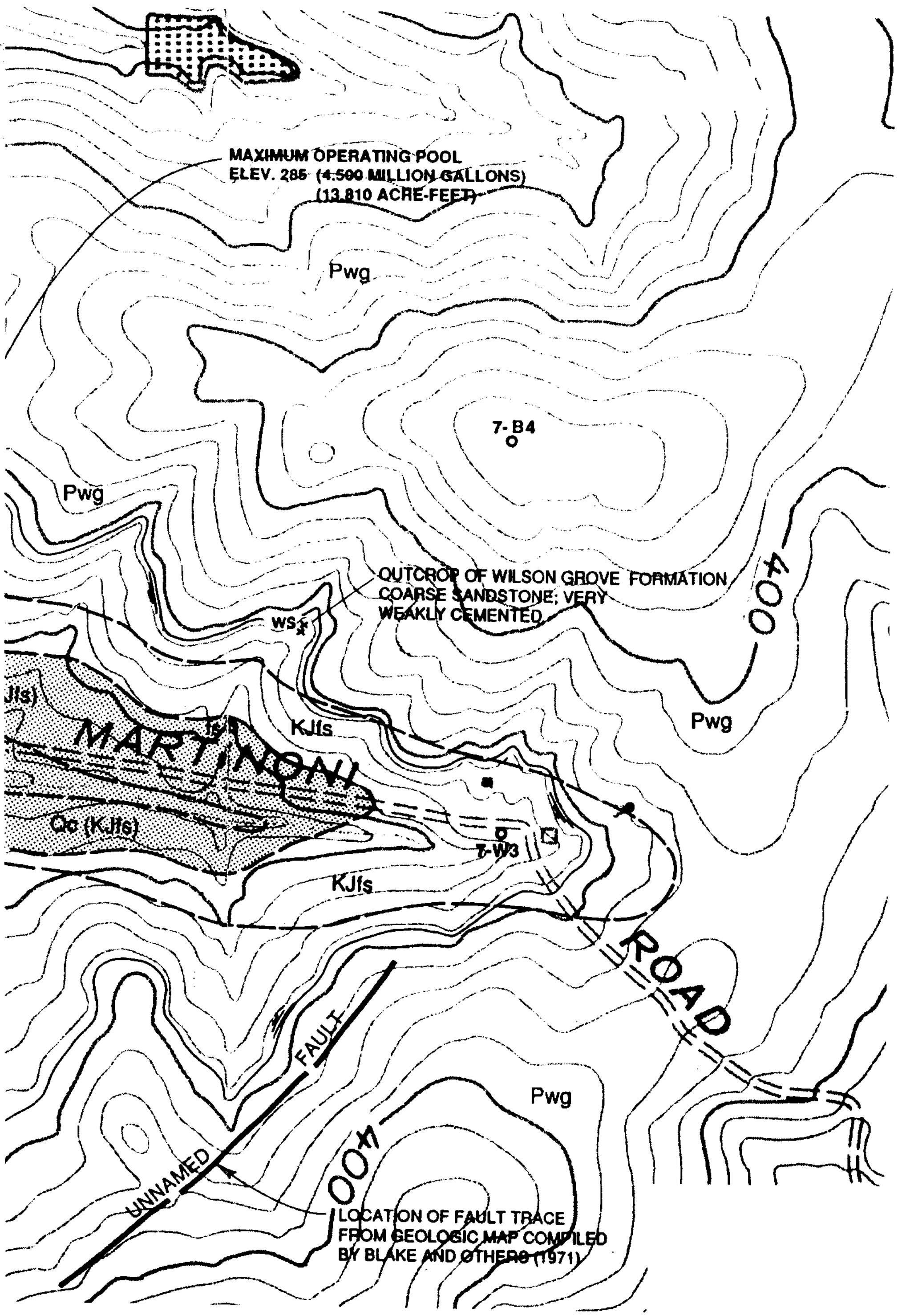
Figure 4.3-9



Source: RUST Environment & Infrastructure

HARLAND BARTHOLOMEW & ASSOCIATES, INC.
PARSONS ENGINEERING SCIENCE, INC.
UNITS OF PARSONS INFRASTRUCTURE & TECHNOLOGY INC.
PARSONS

Santa Rosa



LEGEND

Qal	ALLUVIUM: SANDY CLAY, CLAYEY SAND; SILT VARIABLE AMOUNTS OF GRAVEL; INTERLAY LOCATED ALONG CHANNEL AND ADJACENT
Qc	COLLUVIUM: SANDY CLAY, CLAYEY SAND; AI SHOWN WHERE GREATER THAN ABOUT 4 FE LOCATED IN GENTLE SLOPES ADJOINING VA
Pwg	WILSON GROVE FORMATION (FORMERLY M TION): SILTSTONE AND FINE TO COARSE GR STONE; MASSIVE; WEAKLY CEMENTED; FRIA
KJfs	FRANCISCAN COMPLEX: MELANGE MATERI OF CHAOTIC MIXTURE OF SHEARED, CRUSHE CLAY GOUGE WITH INTERVENING AREAS OF UNSHEARED GRAYWACKE SANDSTONE AND INCLUDES TIGHTLY FOLDED CHERT (ch).
(KJfs)	SYMBOLS IN PARENTHESES INDICATE GEOLOG UNDERLYING SURFICIAL DEPOSITS AS SHOW
	APPROXIMATE GEOLOGIC CONTACT
	FAULT, DASHED WHERE UNCERTAIN
20	STRIKE AND DIP OF BEDDING
	OBSERVED OUTCROP: WILSON GROVE FORM SANDSTONE (ws); FRANCISCAN COMPLEX SA STONE (fs), CHERT (ch), MELANGE (me)
	SPRING
	BOGGY AREA
	EXISTING WELL (EW), PREVIOUS PIEZOMETER OR PREVIOUS BORING (7-B4)
HT-B3	EXPLORATION BORING
HT-P11	TEST PIT
HT-SL2	SEISMIC LINE
A A'	LOCATION OF GEOLOGIC SECTION

NOTE: GEOLOGIC FEATURES SHOWN INCLUDING OUTCROPS WERE NOTED DURING SITE RECONNAISSANCE MAPPI FEBRUARY 27-28, 1995.

	IMPERVIOUS BORROW AREA

NOTE: ONLY THE PRIMARY IMPERVIOUS BORROW SOURCE ARE SOURCES OF OTHER ON-SITE CONSTRUCTION MATERIA RESERVOIR AREA ARE NOT OUTLINED. REFER TO THE EXPLANATION OF ALL BORROW SOURCES.

Santa Rosa Subregional Long-Term Wastewater Project

GEOLOGY of the HUNTLEY RESERVOIR SITE

FI

(3)

LEGEND

Qal	ALLUVIUM: SANDY CLAY, CLAYEY SAND; SILTY SAND WITH VARIABLE AMOUNTS OF GRAVEL; INTERLAYERED; LOCATED ALONG CHANNEL AND ADJACENT FLOODPLAINS.
Qc	COLLUVIUM: SANDY CLAY, CLAYEY SAND; APPROXIMATELY SHOWN WHERE GREATER THAN ABOUT 4 FEET THICK; LOCATED IN GENTLE SLOPES ADJOINING VALLEY FLOOR.
Pwg	WILSON GROVE FORMATION (FORMERLY MERCED FORMATION): SILTSTONE AND FINE TO COARSE GRAINED SANDSTONE; MASSIVE; WEAKLY CEMENTED; FRIABLE.
KJfs	FRANCISCAN COMPLEX: MELANGE MATERIAL CONSISTING OF CHAOTIC MIXTURE OF SHEARED, CRUSHED SHALE AND CLAY GOUGE WITH INTERVENING AREAS OF RELATIVELY UNSHEARED GRAYWACKE SANDSTONE AND GREENSTONE; INCLUDES TIGHTLY FOLDED CHERT (ch).
(KJfs)	SYMBOLS IN PARENTHESES INDICATE GEOLOGIC UNITS UNDERLYING SURFICIAL DEPOSITS AS SHOWN.
	APPROXIMATE GEOLOGIC CONTACT
	FAULT, DASHED WHERE UNCERTAIN
20	STRIKE AND DIP OF BEDDING
	OBSERVED OUTCROP: WILSON GROVE FORMATION SANDSTONE (ws); FRANCISCAN COMPLEX SANDSTONE (fs), CHERT (ch), MELANGE (me)
	SPRING
	BOGGY AREA
	EXISTING WELL (EW), PREVIOUS PIEZOMETER (7-W2), OR PREVIOUS BORING (7-B4)
T-B3	EXPLORATION BORING
·P11	TEST PIT
L2	SEISMIC LINE
A'	LOCATION OF GEOLOGIC SECTION

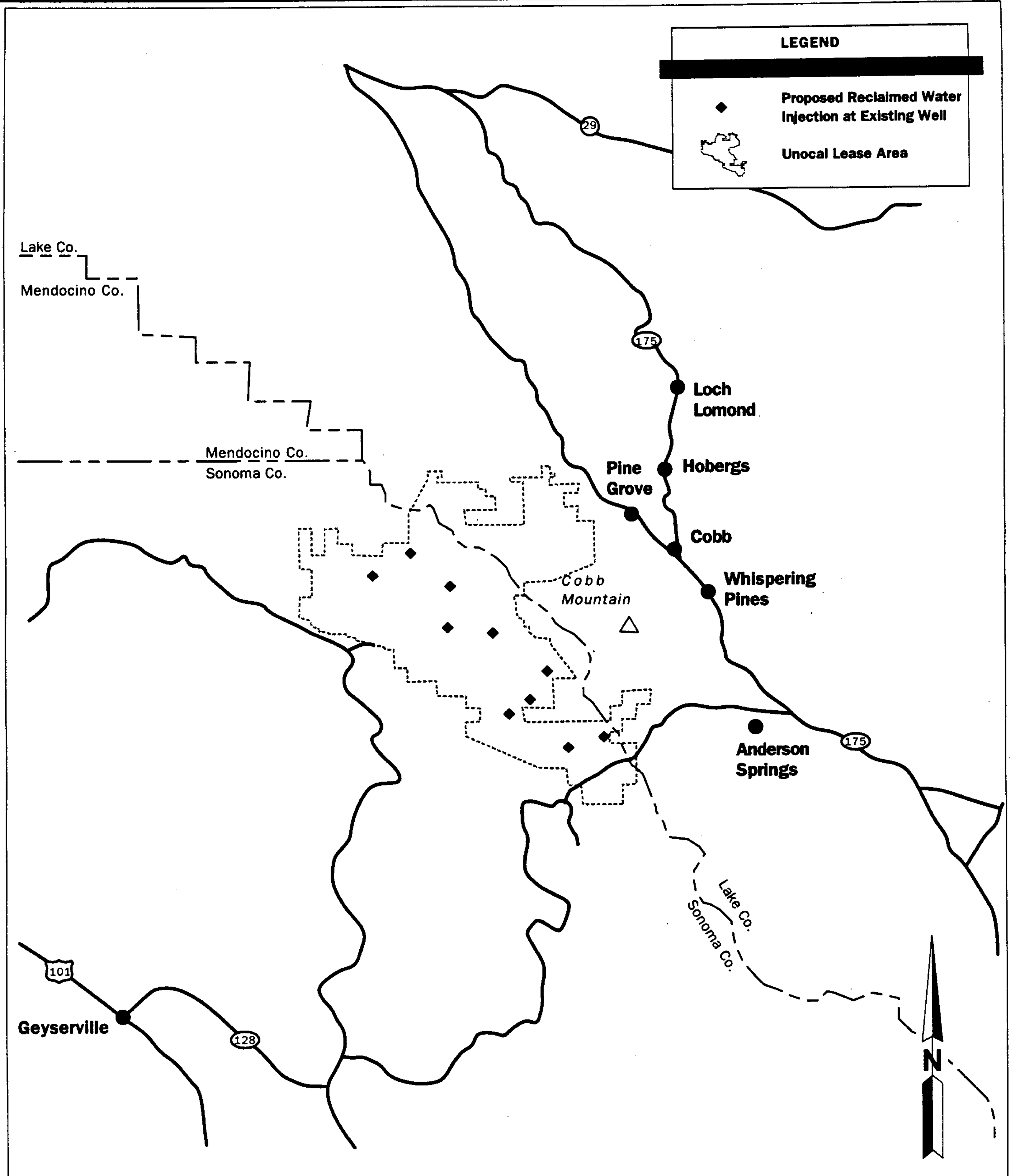
OTE: GEOLOGIC FEATURES SHOWN INCLUDING OUTCROPS AND SPRINGS WERE NOTED DURING SITE RECONNAISSANCE MAPPING ON FEBRUARY 27-28, 1995.

	IMPERVIOUS BORROW AREA

E: ONLY THE PRIMARY IMPERVIOUS BORROW SOURCE AREAS ARE SHOWN. SOURCES OF OTHER ON-SITE CONSTRUCTION MATERIALS WITHIN THE RESERVOIR AREA ARE NOT OUTLINED. REFER TO THE REPORT FOR EXPLANATION OF ALL BORROW SOURCES.

GEOLOGY of the HUNTLEY RESERVOIR SITE

Figure 4.3-10



scale: 1"=12,000'

Source: Parsons Engineering Science

HARLAND BARTHOLOMEW & ASSOCIATES, INC.
PARSONS ENGINEERING SCIENCE, INC.
UNITS OF PARSONS INFRASTRUCTURE & TECHNOLOGY INC.
PARSONS

Santa Rosa

Subregional Long-Term Wastewater Project

GEYSERS LOCATION MAP

Figure 4.3-11

gravel, silt, sand, and clay with minor interbedded tuff. The pipeline route is principally in slightly elevated areas within the Glen Ellen Formation.

Chalk Hill Road from Pleasant Avenue to SR 128 in the Southern Alexander Valley

This segment consists of hilly terrain with intervening valley areas along Brooks and Maacama creeks. The Glen Ellen Formation underlies the southernmost and northern area; shales, siltstones, and sandstones of the Great Valley Group are found in the central portion of this segment. The pipeline alignment crosses these formations and areas underlain by serpentinite and alluvium. The active Healdsburg Fault crosses the alignment in the southern portion of this segment (Figure 4.3-13).

SR 128 from Chalk Hill Road to Alexander Valley Road

This gently sloping area of the Alexander Valley is underlain by alluvium, alluvial fan deposits, and older deposits of gravel, silt, sand, and clay with minor interbedded tuff of the Glen Ellen Formation.

Pine Flat Road from Alexander Valley Road to the Geysers Geothermal Steamfield

This portion of the alignment is located in the Mayacmas Mountains. The pipeline alignment is within Pine Flat Road, which is steep and winding. The area is underlain by Franciscan melange. Coherent blocks of greenstone, chert, serpentine, and sandstone have been mapped along the route.

Several small to large landslides have been mapped along the pipeline alignment and are associated with Franciscan melange and serpentinite. Extensive areas of landslide deposits occur along Pine Flat Road. Disruption of the road pavement by settlement, cracking, scarps, and washouts in several locations is evidence of widespread slope instability in the area. The Pine Flat Road segment of the geysers pipeline route is considered to have a high potential for slope instability (Rust Environment and Infrastructure 1995).

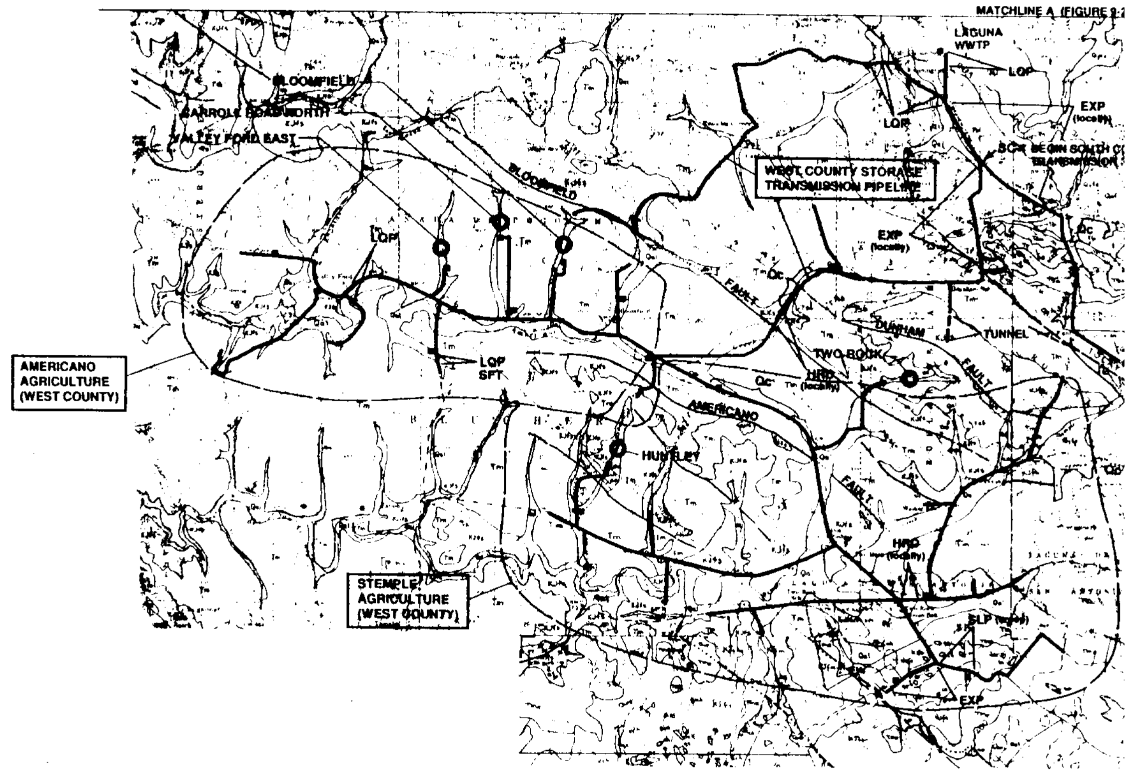
Seismicity

Historical Seismicity

The Project area is located in a seismically active region and earthquakes are a common occurrence. Since the mid-nineteenth century, hundreds of earthquakes have been felt in Sonoma County. A few of these earthquakes were strong enough to cause damage in the Project region.

In the 1800's five moderate earthquakes shook the Santa Rosa area. Three of these earthquakes caused localized minor damage such as broken chimneys in

(1)



EXPLANATION

GEOLOGIC UNITS AND ASSOCIATED GEOTECHNICAL CONDITIONS ALONG PIPELINE ROUTE

GEOLOGIC UNITS SHOWN ON BASE MAP:

Qal	ALLUVIUM: UNCONSOLIDATED SAND, SILT, CLAY AND GRAVEL; MAY CONTAIN LOOSE SILT-SAND LAYERS WHICH MAY BE POTENTIALLY LIQUEFIABLE UNDER HIGH GROUNDWATER CONDITIONS DURING SEISMIC EVENTS.
Qoal Qyf Qyfo Qt Qof	OLDER ALLUVIUM, FAN DEPOSITS, TERRACE DEPOSITS: MIXTURE OF SAND, SILT, CLAY AND GRAVEL; RELATIVELY MORE CONSOLIDATED THAN YOUNGER ALLUVIUM, SHOULD PROVIDE ADEQUATE FOUNDATION
Qls	LANDSLIDE DEPOSITS: INCLUDES LANDSLIDES ASSOCIATED WITH FRANCISCAN COMPLEX MELANGE, SERPENTINE, PETALUMA FORMATION CLAYSTONES, AND SONOMA VOLCANICS TUFF.
QTge Qthg Qtgel	GLEN ELLEN FORMATION AND HUICHICA FORMATION. FLUVIAL DEPOSITS OF GRAVEL, SILT, SAND AND CLAY WITH INTERBEDDED TUFF; RELATIVELY MORE CONSOLIDATED THAN ALLUVIUM; STRONG; SHOULD PROVIDE ADEQUATE FOUNDATION.
Tp Tpc	PETALUMA FORMATION: MASSIVE CLAYSTONE, SILTSTONE, AND MUDSTONE WITH LENSES OF FRIABLE SANDSTONE AND PEBBLE CONGLOMERATE, AND THIN INTERBEDS OF FOSSILIFEROUS LIMESTONE; CLAYSTONE/MUDSTONE/SILSTONE POTENTIALLY UNSTABLE ON HILLSIDE SLOPES; SOILS DERIVED FROM Tp ARE GENERALLY HIGHLY EXPANSIVE.
Tm	WILSON GROVE FORMATION (FORMERLY MERCED FORMATION): SILTSTONE, SANDSTONE, CONGLOMERATE, LIMESTONE CONCRETIONS, TUFF; LOCALLY MASSIVE AND DIFFICULT TO TRENCH EXCAVATE; SHOULD PROVIDE STRONG FOUNDATION.
Tsa Tsr Tsb	SONOMA VOLCANICS: UNDIFFERENTIATED VOLCANICS AND/OR SEDIMENTARY ROCKS; INCLUDES ANDESITE (Tsa), RHYOLITE (Tsr), BASALT (Tsb), TUFF AND OTHER PYROCLASTIC ROCKS. TUFFACEOUS UNITS ARE POTENTIALLY UNSTABLE ON HILLSIDE SLOPES, LOCALLY MASSIVE ANDESITE, RHYOLITE AND BASALT ROCK UNITS MAY BE DIFFICULT TO EXCAVATE.
KJgvs	GREAT VALLEY SEQUENCE: UNDIFFERENTIATED MARINE MUDSTONE, SANDSTONE, SILTSTONE AND CONGLOMERATE; MAY LOCALLY CONTAIN HARD MASSES OF SANDSTONE AND CONGLOMERATE THAT MAY BE DIFFICULT TO EXCAVATE; SHOULD PROVIDE STRONG FOUNDATION
KJfs KJfss KJfm	FRANCISCAN COMPLEX: INCLUDES MELANGE, A CHAOTIC MIXTURE OF FRAGMENTED ROCK MASSES IN A SHEARED SHALY MATRIX; INCLUDES COHERENT BLOCKS OF SANDSTONE, SHALE, CONGLOMERATE, CHERT (ch), GREENSTONE (gs), SERPENTINIZED ULTRAMAFIC ROCKS (sp), METAGRAYWACKE AND BLUESCHIST; ASSOCIATED WITH EXTENSIVE LANDSLIDING IN THE GEYSERS AREA; POTENTIALLY UNSTABLE ON HILLSIDE SLOPES, INCLUDES HARD ROCK MASSES IN MELANGE THAT MAY BE DIFFICULT TO EXCAVATE.

SURFICIAL DEPOSITS NOTED DURING SITE RECONNAISSANCE:

Qc	COLLUVIUM. THICK SOIL (CLAY-SILT-SAND-GRAVEL) AT BASE OF HILLSIDE SLOPES AND AT THE EDGES OF ALLUVIAL VALLEYS; SHOULD PROVIDE ADEQUATE FOUNDATION
Qf	FILL. MOSTLY THICK ROAD EMBANKMENT FILL.

POTENTIAL GEOLOGIC/SEISMIC HAZARDS AND SIGNIFICANT ADVERSE GEOTECHNICAL CONDITIONS ALONG PIPELINE ROUTE

FLT	SURFACE FAULT RUPTURE: ACTIVE FAULT CROSSING ALONG THE HEALDSBURG, RODGERS CREEK AND MAACAMA FAULT ZONES; BRACKETED SEGMENT COINCIDES APPROXIMATELY WITH BOUNDARY OF ALQUIST-PRIOLO SPECIAL STUDIES ZONE
LQP	LIQUEFACTION POTENTIAL. GENERALLY ASSOCIATED WITH UNCONSOLIDATED SILTY AND SANDY ALLUVIAL DEPOSITS AND SHALLOW GROUND WATER; GENERALLY OCCURS ALONG AND NEAR STREAM CHANNELS AND MARSHY AREAS
SLP	SLOPE INSTABILITY: HILLSIDE AREAS UNDERLAIN BY LANDSLIDE DEPOSITS OR POTENTIALLY UNSTABLE MATERIALS INCLUDING THE FRANCISCAN COMPLEX MELANGE, PETALUMA FORMATION CLAYSTONE, AND SERPENTINE SOILS
ERO	EROSION POTENTIAL. HILLSIDE AREAS UNDERLAIN BY POTENTIALLY ERODIBLE MATERIALS SUCH AS FRANCISCAN COMPLEX MELANGE, PETALUMA FORMATION, AND WILSON GROVE FORMATION
SFT	SOFT FOUNDATION MATERIALS. GENERALLY ASSOCIATED WITH VERY SOFT BAY MUD AND SOFT CLAYEY SOILS IN MARSHY AREAS.
HRD	HARD ROCK MATERIALS: MASSIVE SANDSTONE, GREENSTONE, CHERT AND OTHER HARD ROCK MASSES OF THE FRANCISCAN COMPLEX, MASSIVE SILTSTONE/SANDSTONE OF THE GREAT VALLEY SEQUENCE, MASSIVE SANDSTONE AND CONGLOMERATE OF THE WILSON GROVE FORMATION; HARD VOLCANIC ROCKS OF THE SONOMA VOLCANICS WITH ANTICIPATED TRENCH EXCAVATION DIFFICULTY
EXP	EXPANSIVE SOILS: AREAS UNDERLAIN BY SOILS OF THE PETALUMA FORMATION CLAYSTONE, SHEARED SHALE AND CLAY OF THE FRANCISCAN COMPLEX MELANGE, SOILS DERIVED FROM SEVERELY WEATHERED TUFFS OF THE SONOMA VOLCANICS, AND SERPENTINE SOILS

ALTERNATIVE RESERVOIR STORAGE SITE

PIPELINE ROUTE

SLP - HAZARD/CONDITION OCCURRING ALONG APPROXIMATE BRACKETED PIPELINE SEGMENT

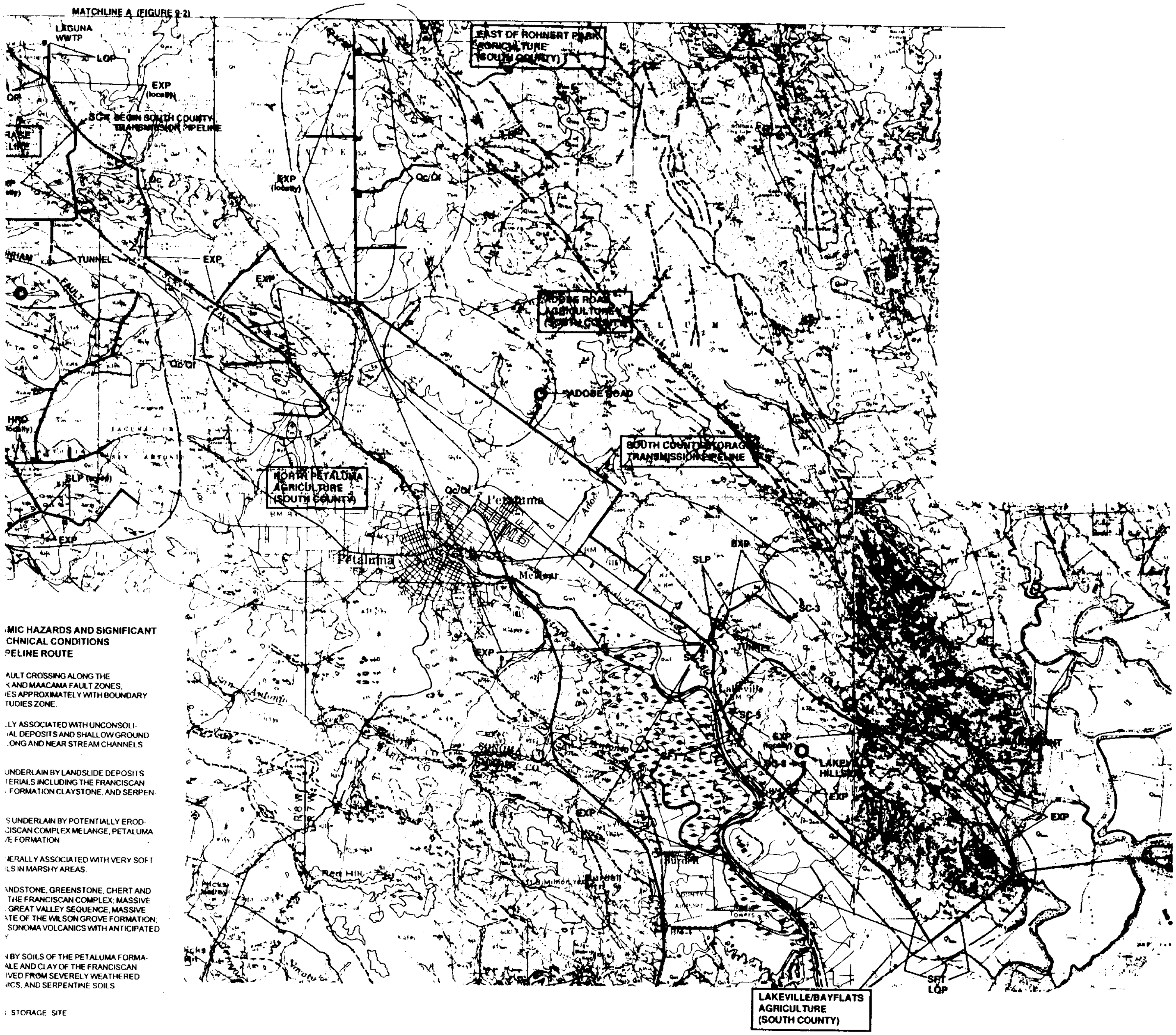
G-1
SC-1 SEGMENT MARKER (DISCUSSED IN TEXT)

PS-G4 PUMP STATION (DESIGNATIONS SHOWN ONLY FOR GEYSERS TRANSMISSION PIPELINE)

AMERICANO AGRICULTURE (WEST COUNTY) PROJECT SEGMENT (DISCUSSED IN TEXT)

N

Source: RUST Environment & Infrastructure



MIC HAZARDS AND SIGNIFICANT
CHNICAL CONDITIONS
PELINE ROUTE

AULT CROSSING ALONG THE
K AND MAACAMA FAULT ZONES,
ES APPROXIMATELY WITH BOUNDARY
TUDIES ZONE

LY ASSOCIATED WITH UNCONSOLI-
AL DEPOSITS AND SHALLOW GROUND
ONG AND NEAR STREAM CHANNELS

UNDERLAIN BY LANDSLIDE DEPOSITS
ERIALS INCLUDING THE FRANCISCAN
FORMATION CLAYSTONE, AND SERPEN

S UNDERLAIN BY POTENTIALLY EROD-
CISCAN COMPLEX MELANGE, PETALUMA
E FORMATION

IERALLY ASSOCIATED WITH VERY SOFT
LS IN MARSHY AREAS

NDSTONE, GREENSTONE, CHERT AND
THE FRANCISCAN COMPLEX; MASSIVE
GREAT VALLEY SEQUENCE, MASSIVE
TE OF THE WILSON GROVE FORMATION,
SONOMA VOLCANICS WITH ANTICIPATED

N BY SOILS OF THE PETALUMA FORMA-
LE AND CLAY OF THE FRANCISCAN
IVED FROM SEVERELY WEATHERED
ICS, AND SERPENTINE SOILS

STORAGE SITE

ITION OCCURRING ALONG APPROXIMATE
PELINE SEGMENT

IONS SHOWN ONLY FOR
RANSMISSION PIPELINE)

PROJECT SEGMENT
(DISCUSSED IN TEXT)

BASE FROM PRELIMINARY GEOLOGIC MAP OF WESTERN SONOMA COUNTY AND NORTHERNMOST MARIN COUNTY, BLAKE AND OTHERS, 1971; PRELIMINARY GEOLOGIC MAP OF EASTERN SONOMA COUNTY AND WESTERN NAPA COUNTY, FOX AND OTHERS, 1973; PRELIMINARY GEOLOGIC MAP OF MARIN AND SAN FRANCISCO COUNTIES AND PARTS OF ALAMEDA, CONTRA COSTA, AND SONOMA COUNTIES, BLAKE AND OTHERS, 1973; PRELIMINARY GEOLOGIC MAP OF SOLANO COUNTY, AND PARTS OF NAPA, CONTRA COSTA, MARIN AND YOLO COUNTIES, SIMS AND OTHERS, 1973.

SCALE
6000 0 6000 FEET

NOTES
1. PIPELINE ALIGNMENTS PROVIDED BY PARSONS ENGINEERING SCIENCE
2. ONLY PROPOSED ALTERNATIVE TRANSMISSION PIPELINE ALIGNMENTS ARE SHOWN. EXISTING PIPELINES WHICH SUPPLY SOME OF THE PROPOSED PIPELINES ARE NOT SHOWN.
3. POTENTIAL HAZARDS AND GEOTECHNICAL CONDITIONS SHOWN ARE BASED ON REVIEW OF AVAILABLE PUBLISHED DATA AND SITE RECONNAISSANCE CONDUCTED ON OCTOBER 4-6, 1995

Santa Rosa
Subregional Long-Term
Wastewater Project

**GEOLOGIC and
SEISMIC HAZARDS
GEYSERS PIPELINE ROUTE SOU**

Fig

(5)

NOTES 1 PIPELINE ALIGNMENTS PROVIDED BY PARSONS ENGINEERING SCIENCE.

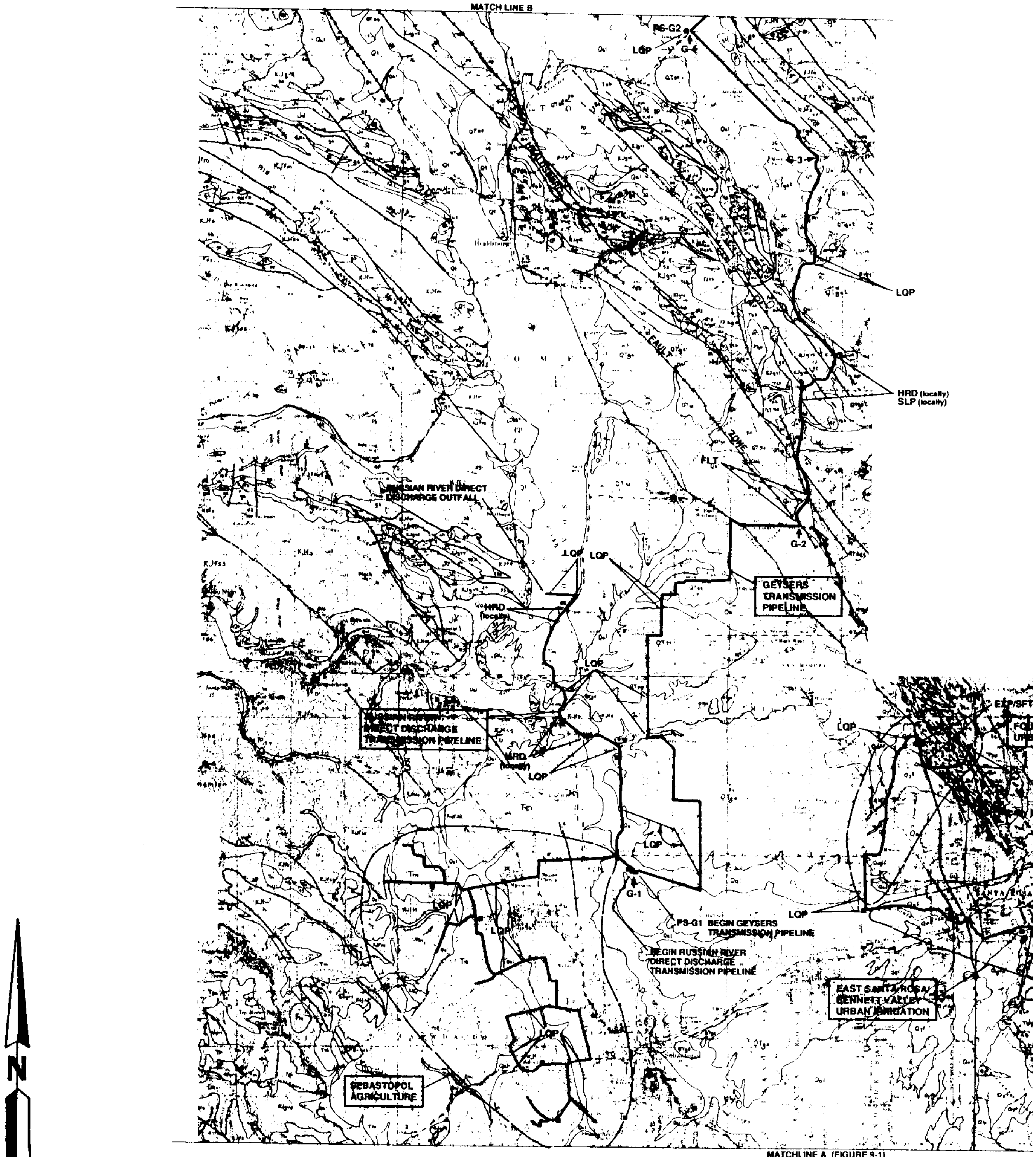
2. ONLY PROPOSED ALTERNATIVE TRANSMISSION PIPELINE ALIGNMENTS ARE SHOWN. EXISTING PIPELINES WHICH SUPPLY SOME OF THE PROPOSED PIPELINES ARE NOT SHOWN.

3 POTENTIAL HAZARDS AND GEOTECHNICAL CONDITIONS SHOWN ARE BASED ON REVIEW OF AVAILABLE PUBLISHED DATA AND SITE RECONNAISSANCE CONDUCTED ON OCTOBER 4-6, 1995

GEOLOGIC and SEISMIC HAZARDS GEYSERS PIPELINE ROUTE SOUTH

Figure 4.3-12

(1)



BASE FROM P
COUNTY, BLA
WESTERN NA
SAN FRANCIS
AND OTHERS,
COSTA, MARI

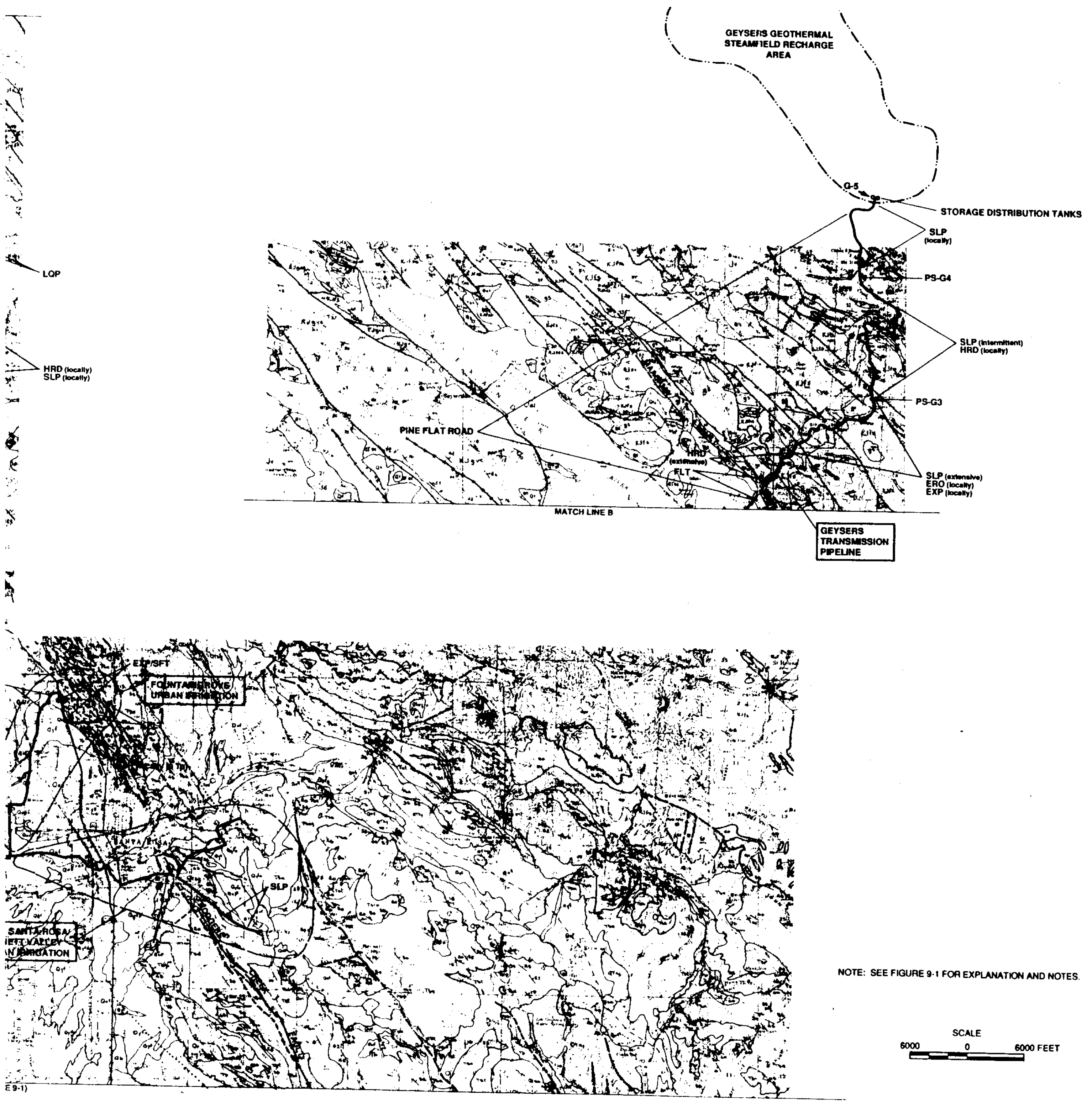
Source: RUST Environment & Infrastructure

HARLAND BARTHOLOMEW & ASSOCIATES, INC.
PARSONS ENGINEERING SCIENCE, INC.
UNITS OF PARSONS INFRASTRUCTURE & TECHNOLOGY INC.

PARSONS

Santa Ros

2



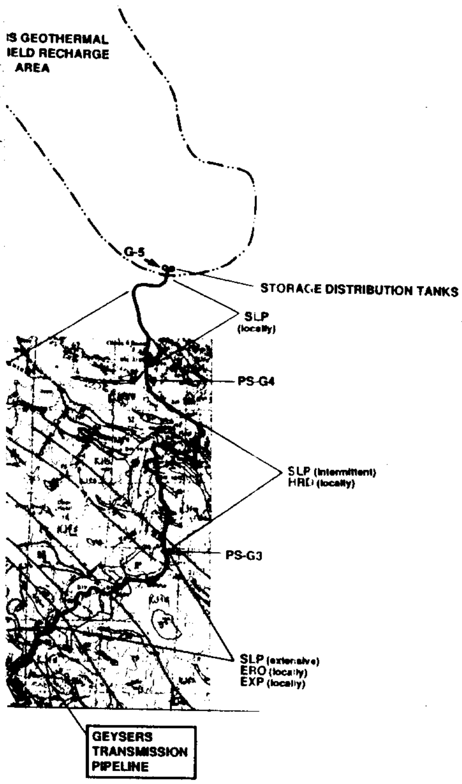
BASE FROM PRELIMINARY GEOLOGIC MAP OF WESTERN SONOMA COUNTY AND NORTHERNMOST MARIN COUNTY, BLAKE AND OTHERS, 1971; PRELIMINARY GEOLOGIC MAP OF EASTERN SONOMA COUNTY AND WESTERN NAPA COUNTY, FOX AND OTHERS, 1973; PRELIMINARY GEOLOGIC MAP OF MARIN AND SAN FRANCISCO COUNTIES AND PARTS OF ALAMEDA, CONTRA COSTA, AND SONOMA COUNTIES, BLAKE AND OTHERS, 1973; PRELIMINARY GEOLOGIC MAP OF SOLANO COUNTY, AND PARTS OF NAPA, CONTRA COSTA, MARIN AND YOLO COUNTIES, SIMS AND OTHERS, 1973.

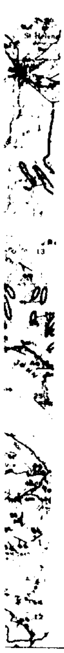
Santa Rosa Subregional Long-Term Wastewater Project

GEOLOGIC and SEISMIC HAZARDS GEYSERS PIPELINE ROUTE NO

Fig

3





NOTE: SEE FIGURE 9-1 FOR EXPLANATION AND NOTES.

SCALE
6000 0 6000 FEET

GEOLOGIC and SEISMIC HAZARDS GEYSERS PIPELINE ROUTE NORTH

Figure 4.3-13

Santa Rosa in 1865, 1893, and 1899. These earthquakes ranged in magnitude from less than 4 to 5.1. The first two epicenter locations were inferred to be in Bennett Valley and the third in Santa Rosa based on detailed analysis of historical accounts and newspaper records (Toppozada, Real, and Parke 1981). In 1891 a magnitude 5.5 earthquake centered near Napa caused minor damage in Santa Rosa and in 1898 a strong earthquake (magnitude 6.2) centered east of the southern end of the Rodgers Creek Fault, severely damaged buildings at Mare Island Naval Shipyard and caused structural damage in Petaluma and Santa Rosa.

The great San Francisco earthquake (18 April 1906) on the San Andreas Fault had an estimated magnitude of 8.3 on the Richter scale. The geology, geophysics, and damage reports of this earthquake were reported by the State Earthquake Investigation Commission (Lawson 1908). The following description is based on Lawson's report *California Earthquake of April 18, 1906*.

> The 1906 earthquake caused extensive damage in San Francisco and in other communities in the Bay Area. Santa Rosa, Sebastopol, and Fort Bragg sustained relatively more damage than most other places in California during the earthquake. In Santa Rosa strong ground shaking and a fire in the downtown area resulted in extensive property damage in the business district. Approximately 61 people were killed in Santa Rosa (Lawson 1908).

Ground shaking intensity effects from the 1906 earthquake varied throughout the project area. The extent of damage was influenced by geologic conditions, the design and workmanship of building construction, and other factors. Damage reports from Santa Rosa and Sebastopol of collapsed buildings and ground cracking indicate ground shaking intensities of IX to X on the Modified Mercalli Scale (see Table 4.3-1).

Table 4.3-1

Modified Mercalli Intensity Scale

I.	Not felt except by a very few under especially favorable circumstances.
II.	Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended object may swing.
III.	Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing motorcars may rock slightly. Vibration like passing of truck. Duration estimated.
IV.	During the day felt indoors by many, outdoors by few. At night some awakened. Dishes, windows, doors disturbed; walls make creaking sound. Sensation like heavy truck striking building. Standing motorcars rocked noticeably.

Table 4.3-1

Modified Mercalli Intensity Scale

V.	Felt by nearly everyone, many awakened. Some dishes, windows, and so on broken; cracked plaster in a few places; unstable objects overturned. Disturbances of trees, poles, and other tall objects sometimes notices. Pendulum clocks may stop.
VI.	Felt by all, many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster and damaged chimneys. Damage slight.
VII.	Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving cars.
VIII.	Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Persons driving cars disturbed.
IX.	Damage considerable in specially designed structures; well designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken.
X.	Some well built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable from river banks and steep slopes. Shifted sand and mud. Water splashed, slopped over banks.
XI.	Few, if any, (masonry) structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.
XII.	Damage total. Waves seen on ground surface. Lines of sight and level distorted. Objects thrown into the air.

[1] Abridged Modified Mercalli Intensity Scale (1956 version)

Some of the extreme damage in this area was attributed to poor building construction. In Valley Ford and Bloomfield reports indicate that ground shaking intensities were about IX on the Modified Mercalli Scale. In Valley Ford walls fell from brick buildings, houses were shifted off foundations, and chimneys collapsed. Ground cracking was reported in the valley floor. In Bloomfield reports indicate that "two brick buildings, two stores and a dwelling were wrecked" and that several frame buildings were shifted from their foundations. No reports of damaged pipes or visible surface waves were recorded. Damage reports from Petaluma and Lakeville of substantial cracking in plaster, fallen chimneys and damage to brick buildings indicate ground shaking intensity of about VIII on the Modified Mercalli Scale (Lawson 1908).

The October 1969 magnitude 5.6 and 5.7 earthquakes on the Healdsburg Fault caused several million dollars of damage in Santa Rosa and the vicinity. Numerous breaks in the water pipeline system occurred in the eastern part of Santa Rosa. More recently, the magnitude 4.9 earthquake along the Hayward Fault (26 January 1986) and the magnitude 7.1 Loma Prieta earthquake on the San Andreas Fault (17 October 1989) were felt in the County, but no damage was reported to major pipeline facilities.

Numerous instances of ground failure and liquefaction effects were recorded after the 1906 earthquake and again in 1969. These soil failures occurred predominantly in marshy ground and areas near the trace of the Healdsburg-Rodgers Creek Fault in central Santa Rosa. In 1969 ground cracking was common along the banks of Matanzas Creek and Santa Rosa Creek (Youd and Hoose 1978).

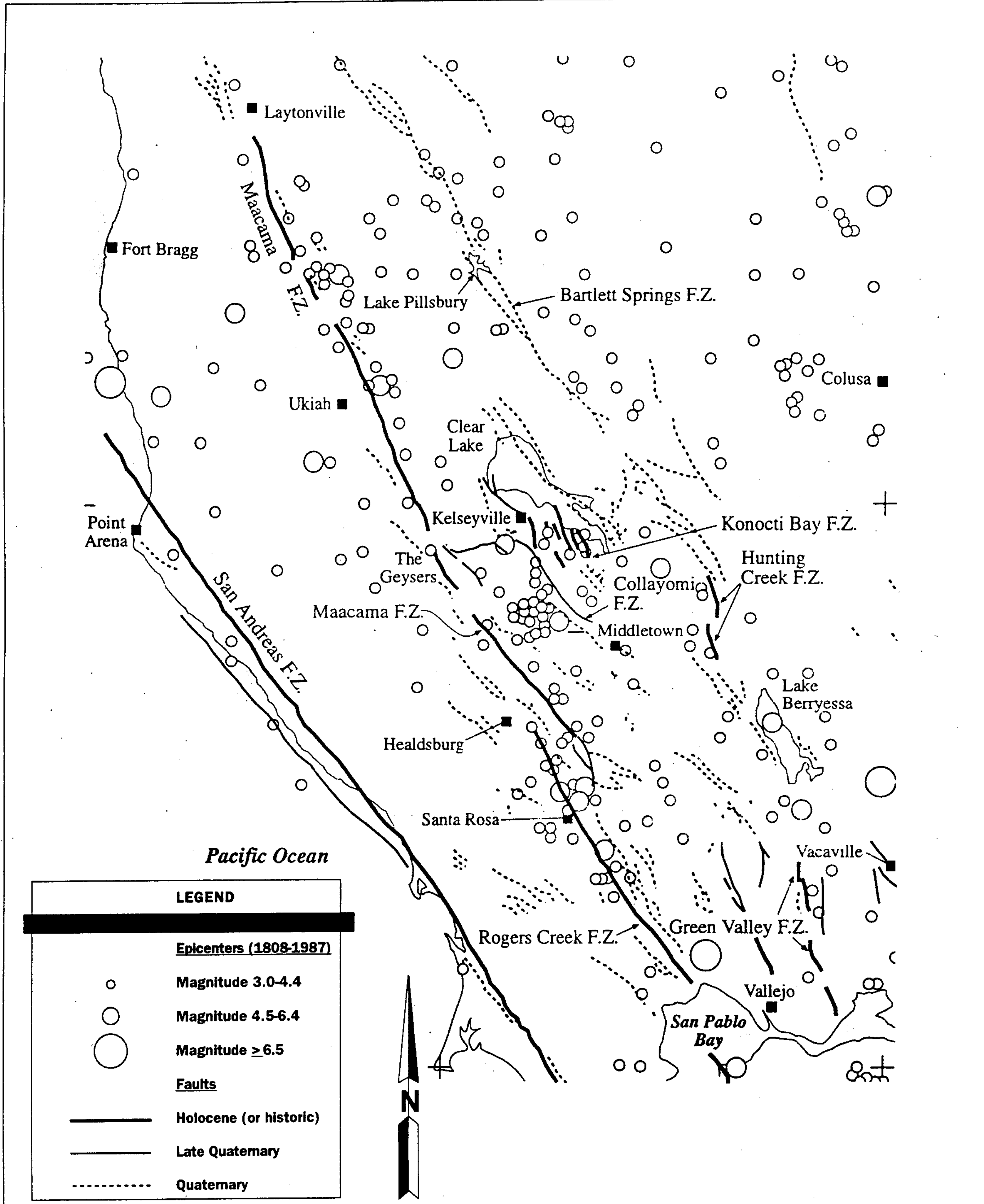
In 1990 the U.S. Geological Survey estimated the probability of large earthquakes occurring on major active faults in the San Francisco Bay Area. The 30-year probability of a magnitude 7 earthquake occurring on the Rodgers Creek Fault was estimated at 22 percent (U.S. Geological Survey 1990). There is a 67 percent probability of one or more large earthquakes occurring in the greater Bay Area within the same period of time (U.S. Geological Survey 1990).[4]

Geysers Seismicity

The northern portion of the geysers area (Unocal lease area) is extremely active seismically (Figure 4.3-14). Earthquakes occur at apparently random intervals rather than in related groups or swarms and generally have epicenters less than 20,000 feet deep. Seismic monitoring has demonstrated that the rate of earthquake occurrence increased as steam development increased from the 1960s to the 1970s. Studies have revealed a correspondence between production wells, episodes of water injection, and earthquakes (Stark 1991, Greensfelder 1993). Both steam production and injection of water to restore production may induce seismic activity.

Baseline seismicity at the geysers, before geothermal development began, is not well documented. It appears that the currently high rate of seismicity in the vicinity of the geysers geothermal area began in the early 1960s, shortly after initiation of commercial steam power generation. Studies of induced seismicity in the geysers area began in 1971 and by 1972 regional seismographic monitoring capabilities were established. At that time numerous small earthquakes with epicenters in the geysers geothermal area began to be routinely reported. Since 1975 more that 20,000 earthquakes with magnitudes ranging from 0.7 to 3.0 and

[4] Because these estimates are based on the estimated recurrence interval of earthquakes on each fault and five years has elapsed since the analysis without a major earthquake, current probabilities would be slightly higher than those reported in 1990.



Source: Greensfelder and Associates, 1995

GEYSERS REGIONAL FAULTS and SEISMICITY

Figure 4.3-14

about 300 larger earthquakes (magnitudes ranging from 3.0 to 4.6) have been reported to originate at the geysers. In the period from 1975 to 1985, 21 were reported felt in Cobb (Greensfelder and Parsons 1995). Felt earthquakes reported from Cobb during this 10-year period ranged in intensity from II to V on the Modified Mercalli Scale with three of the 21 reported events classified as Modified Mercalli V (earthquakes in May 1982, June 1983, and September 1984).

Based on the documented parallel increase of seismicity rates and geothermal development, including steam production and water/steam condensate injection, it has been established that these activities cause earthquakes (Greensfelder 1993). It is generally accepted that injection can generate earthquakes in the vicinity of wells by increasing water pressure on pre-existing fracture planes in the reservoir rock. This pressure reduces resistance to shearing and permits the release of natural tectonic stress and strain. However, the detailed mechanism of the release of natural elastic energy is not completely understood.

Static stress modeling calculations indicate that the small earthquakes induced at the geysers do not contribute to the risk of larger earthquakes on nearby faults (Greensfelder and Parsons 1995).

Faults

There are several fault zones within Sonoma County that could affect Project facilities (Figure 4.3-1). These include active faults, which are faults that may have been historically active (during the last 200 years) or active in the geologically recent past (about the last 11,000 years, usually referred to as Holocene in the geologic time scale). Faults that have been active at some time during the Quaternary geologic period (the last two million years) are classified as potentially active.

The San Andreas, Healdsburg-Rodgers Creek, Maacama, Konocti Bay, West Napa, Green Valley, and Bartlett Springs Fault zones are all Holocene in age and considered active (Table 4.3-2). Portions of some of the major fault zones have been classified as Quaternary because they do not display evidence of Holocene movement, but displace geologic units of Quaternary age (last two million years). Regional faults that are classified as Quaternary age are the Tolay, Americano Creek, Bloomfield, Dunham, Collayomi, Geyser Peak, and Cobb Mountain Fault zones (Wagner and Bortugno 1982). Characteristics of faults that could affect project facilities are listed in Table 4.3-2. Faults not listed in Table 4.3-2 would not affect Project facilities because of their age, distance, or seismic potential. Refer to the Geotechnical Evaluation of Alternative Reservoir Sites and Pipeline Routes (Rust Environment and Infrastructure, Inc. 1995) for detailed discussion of fault activity and relationship to Project structures.

Faults near Reservoir Sites

The southeastern segment of the Tolay Fault (Table 4.3-1 and Figure 4.3-2) was zoned as an Alquist-Priolo earthquake fault zone in 1976[5], but was removed from the zone in 1982 on the basis of Fault Evaluation Report 140 (Hart 1982). The fault was removed from the earthquake fault zone[6] because it did not meet the criteria for zoning under the California Division of Mines and Geology fault evaluation program, that is, "only those faults considered active (Holocene) and well defined as surface structures are zoned." Trenching across the postulated trace of the Tolay Fault in the west saddle dam area and downstream of the main dam site revealed landslide deposits that did not show evidence of faulting. Because the age of the landslide deposits is not known the trench investigation does not provide conclusive information about the age of the fault (Rust Environment and Infrastructure, Inc. 1995).

The Tolay Fault is classified as a Quaternary-age fault because evidence of displacement within the last 2 million years has been documented. According to Hart (1982), if the Tolay Fault is active in the Holocene then such activity is minor, distributive, and restricted to the southeastern segment of the fault where it is in proximity to the well-defined and active Rodgers Creek Fault. Although the Tolay Fault does not meet the criteria for an earthquake fault zone under the Alquist-Priolo Act and is not considered to be a surface rupture hazard, the fault is considered to be capable of producing a magnitude 6.5 earthquake and could produce strong ground shaking (Wesnousky 1986).

The Dunham, Bloomfield, and Americano Creek Faults are mapped as Quaternary faults and therefore are considered potentially active, according to the Division of Mines and Geology definition discussed above (Table 4.3-2). These faults separate Franciscan Complex rocks from Wilson Grove Formation rocks in the West County.

The Dunham Fault is about four miles long, sub-parallel to the northwest segment of the Tolay Fault. Bortugno (1982) classifies the Dunham Fault as a Quaternary fault, however, this designation does not preclude the possibility that Holocene movement may have occurred. No evidence of Holocene displacement was identified during geotechnical investigations in the vicinity of Two Rock by Woodward-Clyde Consultants (1989).

The Bloomfield Fault was previously studied by Woodward-Clyde Consultants (1990) as part of earlier geotechnical investigations of a proposed dam in the Two Rock area. Their investigation consisted of interpretation of aerial photographs, geologic reconnaissance, and two shallow excavations. The fault zone is up to 11 feet wide and consists of fractures, shears, and gouge. Alluvial deposits of

---

[5] In January 1994, state law renamed this the Alquist-Priolo Earthquake Fault Zoning Act

[6] These zones are now referred to as earthquake fault zones

possibly late Quaternary-age have not been displaced by the fault. Based on these data, Woodward-Clyde concluded that the Bloomfield Fault does not show evidence of Holocene or late Quaternary activity.

The Americano Creek Fault is considered to be Quaternary in age and potentially active. However, the short length of the fault suggests that it would not be capable of generating a major earthquake.

Geysers Faults

The Maacama Fault is a recognized Holocene Fault that is located about four miles southwest of the geysers geothermal area (Table 4.3-2). The Green Valley Fault, also Holocene, extends from Suisun Bay 55 miles northeast along the west side of Lake Berryessa and has recently been extended north to connect with the Hunting Creek Fault (Figure 4.3-13). These active faults are zoned under the Alquist-Priolo Earthquake Fault Zoning Act.

The Bartlett Springs Fault, located 20 miles east of the Maacama Fault, has displaced Holocene alluvium in several segments, and alignments of seismicity suggest that the fault is active. The largest earthquake magnitudes associated with this Bartlett Springs Fault have been about magnitude 5.

The Konocti Fault is a Holocene fault that may be responsible for three historic earthquakes. In 1954, a magnitude 4.4 earthquake caused slight damage at Lakeport. Two other earthquakes occurred near Kelseyville in 1955 and had magnitudes of 3.6 and 4.6 to 5.0. The first of these broke chimneys and windows at Lower Lake and the second had similar effects and was felt over a 1,700 square mile area.

The Collayomi Fault is located about 10 miles northwest of the Maacama Fault and is mapped as late Quaternary (Jennings et al. 1994). The Big Valley Fault, located just northeast of the geysers geothermal area, is considered to be a prominent splay of the Collayomi Fault.

The Geyser Peak and Cobb Mountain Faults have been mapped in the vicinity of the geysers. These faults are classed as early Quaternary (700,000 years to 2 million years old) and are considered to be inactive. Numerous other pre-Quaternary faults are present in the vicinity of the geysers. These older faults generally are related to the coastal thrust belt or the Coast Ranges thrust fault. They were active tens of millions of years ago, but have not shown evidence of activity during the last two million years.

Table 4.3-2

Faults that Could Affect Project Facilities

Fault	Location (refer to Figures 4.3-1 and 4.3-14)	Age	Method of Estimating Activity Level	Maximum Credible Earthquake (Magnitude - Richter Scale)	Alquist-Priolo Earthquake Fault Zone (Yes/No)
Americano Creek	From Two Rock, northwest along Americano Creek for about six miles	Quaternary	Refer to Faults text, above	Not available	No
Bartlett Springs	20 miles east of the Maacama Fault, from east of Clear Lake to south of Covelo in Mendocino County	Holocene	Displaced alluvium in several segments and alignments of seismicity	7 (Lake County Sanitation District, 1994)	No
Bloomfield	Extends for about nine miles and is two miles northeast of Bloomfield	Quaternary	Refer to Faults text, above	Not available	No
Collayomi-Big Valley	Northeast of the geysers geothermal area and 10 miles northwest of the Maacama Fault	Quaternary	Refer to Faults text, above	6.6 (Wenousky 1986)	No
Dunham	Extends for about four miles and is located one to two miles south of the Tolay Fault	Quaternary	Refer to Faults text, above	Not available	No
Green Valley	Extends 55 miles from Suisun Bay to south of Clear Lake	Holocene	Measured creep of 4 mm/year and associated seismicity	6.9 (Wenousky 1986)	No
Green Valley	Extends from Suisin Bay 55 miles northeast along the west side of Lake Berryessa	Holocene	Fault creep and aligned seismicity	6.9 (Wenousky 1986)	Yes
Healdsburg-Rodgers Creek	From the Bay portion of Sonoma County, through Santa Rosa and Healdsburg	Holocene	Historic damaging earthquake	7 (CDMG 1994)	Yes

Table 4.3-2

Faults that Could Affect Project Facilities

Fault	Location (refer to Figures 4.3-1 and 4.3-14)	Age	Method of Estimating Activity Level	Maximum Credible Earthquake (Magnitude - Richter Scale)	Alquist-Priolo Earthquake Fault Zone (Yes/No)
Konocti Bay	Southern portion of Clear Lake	Holocene	A complex arrangement of short faults associated with abundant small earthquakes (magnitudes less than 4.4). One fault has caused a 3-foot high offset in lake bottom sediments	7 (Lake County Sanitation District, 1994)	No
Maacama	Extends 90 miles from east of Healdsburg (forms the base of the Mayacmas Mountains) to Laytonville	Holocene	Measured slip rate of 2 to 5 millimeters per year	7.6 (Wenousky 1986)	Yes
San Andreas	Along the Mendocino/Sonoma County coast line (through Tomales Bay) and off-shore	Holocene	Historic surface rupture and damaging earthquake	8.3 (CDMG 1982)	Yes
Tolay	From Sears Point for 22 miles to a location about 6 miles southwest of Santa Rosa	Quaternary	Refer to Faults text, above	6.5 (Wenousky 1986)	No
West Napa	South and West of Napa near the Napa River	Holocene	Holocene fault displacement	6.5 (Wenousky 1986)	No

Source: Jennings, 1994; Wenousky , 1986; Lake County Sanitation District, 1994; ABAG, 1995; CDMG, 1990.;

Geologic Hazards

Major geologic hazards that may be present within the region range from unstable geologic conditions to potential seismic activity. This section discusses some of the mechanisms of geologic instability. Geologic conditions at specific alternative sites are discussed in the appropriate setting section, above.

Slope Instability

Landsliding is a natural process in the Coast Ranges and is a common occurrence in certain types of geologic materials. Geologic materials rich in clay minerals have a great capacity to absorb water, resulting in reduction of shear strength. The force of gravity can cause landslides when saturated clays reduce the shear strength of a rock below its minimum stability threshold. Among the potentially unstable geologic formations in the Project region are the clay-rich Petaluma Formation and the sheared and fractured shale matrix of the Franciscan Complex. Another unstable configuration may occur where the angle of dip of bedding planes and the cut slope result in daylighting of bedding or bedding planes that are parallel to the surface of the ground. In these cases the potential exists for rock units to slip along a weakened plane.

The steepness of a slope is a major factor in slope stability. Human modifications of topography and drainage such as road cuts, surface runoff diversion, or impounding water can reduce the natural shear strength of slopes and generate landsliding, even in areas of normally low susceptibility.

Several other conditions can cause, or contribute to, slope instability. Heavy rains can saturate slopes, reduce shear strength, and result in failure. Stream cuts along the base of a slope can undermine the slope and possibly induce sliding. Chemical and mechanical weathering can break down rock materials, and the seepage from high groundwater levels can increase water concentration, thus reducing strength.

Slope stability hazards at the reservoir sites were evaluated during geotechnical investigations at each reservoir site (Rust Environment and Infrastructure, Inc. 1995). Three slope instability hazard categories for landsliding risk potential (low, moderate, and high) were established based on the abundance of existing landslides, slope gradients, and strength of the underlying geologic material.

Two Rock, Bloomfield, Carroll Road, Valley Ford, and Huntley reservoir sites are considered to have low landsliding risk, based on the limited extent of existing slope instability and the presence of generally stable geologic materials of the Wilson Grove Formation and the Franciscan Complex. Moderate landsliding risk exists at the Tolay and Sears Point reservoir site where slope gradients are moderately steep and bedrock consists of the less stable Petaluma Formation. The Adobe Road and Lakeville Hillside sites are considered to have high landsliding

risk based on the presence of numerous and large landslides that occur in the underlying Petaluma claystone and because of steep slope conditions.

Earthquake-induced Slope Instability

Bedrock formations and unconsolidated deposits (soils) respond differently to seismically induced ground shaking. As a general rule, the severity of ground shaking increases with proximity to the epicenter of the earthquake. However, given similar location and seismic energy output, the least amount of damaging vibration would occur on a site that was entirely underlain by bedrock. A site underlain by a major thickness of alluvium would experience considerably more damaging vibration because of the unconsolidated material's tendency to deform to a greater degree than the bedrock.

Earthquake-induced landsliding of steep slopes can occur in either bedrock or unconsolidated deposits. Firm bedrock can usually support steeper, more stable slopes than slopes cut in unconsolidated or poorly consolidated material. However, rock type, grain size, degree of consolidation, and bedding angle all contribute to the strength or weakness of a bedrock hillside. Shales and deeply weathered rocks are very susceptible to slope failures during strong seismic ground shaking. Project component sites that have a moderate to high risk of landsliding would also be at risk for earthquake-induced slope failure.

Seismic Hazards

Seismic hazards include ground shaking, surface rupture along active faults, and liquefaction. Strong ground shaking can damage structures, their foundations, and contents. Strong ground shaking may also trigger secondary effects such as liquefaction or ground settlement in some areas. Ground shaking intensity of IX on the Modified Mercalli Scale (Table 4.3-1) could damage well built structures and rupture pipes.

Damage due to surface rupture is limited to the actual location of the fault-line break, unlike damage from ground shaking that can occur at great distances from the fault. Surface rupture could damage buried pipelines that have not been adequately protected where they cross fault traces. In the Project region the Healdsburg-Rodgers Creek Fault and the Maacama Fault are active faults with potential for surface rupture that could affect Project facilities.

A common hazard related to severe ground shaking in loose saturated sandy soils is liquefaction. This transformation from a solid to a liquid ("quicksand") state can cause ground settling, landsliding, and lateral spreading[7]. Alluvial areas adjoining streams and in valleys and shorelines are areas where liquefaction can occur if specific conditions exist such as loose sandy deposits and high

[7] Lateral spreading may result if liquefaction occurs in material that makes up a slope, particularly a free-face, such as along river banks.

groundwater conditions. If loose granular soils (predominately silt and fine sand) are present and seasonal maximum groundwater levels are within 20 feet of the ground surface there is a high potential for liquefaction (California Division of Mines and Geology 1974). If groundwater levels in liquefaction prone soil are between 20 feet and 50 feet of the ground surface there is a moderate potential for liquefaction to occur (California Division of Mines and Geology 1974). Liquefaction in sediment where the groundwater is more than 50 feet below the ground surface does not generally result in surface ground failure. Portions of the study area that could be affected by liquefaction are shown in figures 4.3-12 and 4.3-13.

Soils

The following description of soils in the Project area is based on soil surveys of Sonoma County and Marin County prepared by the U.S. Soil Conservation Service (1972 and 1985). The soils of Sonoma County belong to two major groups which are subdivided into 15 associations (Table 4.3-3). The major soil groups are related to the substrate on which the soils have developed. Soils in the basins and on tidal flats, flood plains, terraces, and alluvial fans were developed on the unconsolidated deposits of the valleys and shores. Soils of the high terraces, foothills, uplands, and mountains generally were developed on bedrock terrain or on bedrock thinly overlain by unconsolidated material.

Soils of the Huichica-Wright-Zamora Soil Association have developed on low terraces and alluvial fans in the Cotati-Petaluma Valley. West of the Laguna de Santa Rosa, the majority of the soils belong to the Hugo-Josephine-Laughlin association, which occurs on the mountainsides east of the Pacific Coast. Soils of the Goldridge-Cotati-Sebastopol Association are used for apple orchards near Sebastopol. In the vicinity of the geysers, various soil associations including the Spreckels-Felta, Yorkville-Suther, and Hugo-Josephine-Laughlin have developed on steeply sloping terraces and uplands. The Stemple/Americano Creek area contains two associations: the Steinbeck-Los Osos association in the uplands and the Pajaro Association along creeks. The Russian River Valley from Alexander Valley (Jimtown) to Cloverdale consists of the Yolo-Cortina-Pleasanton Association, which developed on the nearly level or moderately sloping valley floor. From Santa Rosa southeast to San Pablo Bay, soils of the Clear Lake-Reyes and Haire-Diablo Associations dominate. A summary description of each soil association is provided in Table 4.3-3, and their characteristics are listed in Table 4.3-4.

Table 4.3-3

Soil Associations

Soil Association	Description
Clear Lake Reyes	Principally occur along Laguna de Santa Rosa and cover much of the area from Rohnert Park-Cotati downstream to San Pablo Bay. Poorly drained, consisting of nearly level to gently sloping clays and clay loams. Used mainly for irrigated pasture. Correspond to the Reyes-Novato soils in Marin County.
Haire-Diablo	Occur from the south end of the Santa Rosa plain to near San Pablo Bay. Moderately well-drained to well drained, gently sloping to steep fine sandy loams to clays. Used mainly for dry land pasture, with some hay cropping.
Huichica-Wright-Zamora	Cover most of the Santa Rosa plain. Somewhat poorly drained to well drained, nearly level to strongly sloping, loams to silty clay loams. Principal use of soils is for pasture and hay.
Pajaro	Occur along Green Valley Creek (west of Sebastopol), along Estero Americano (south of Bodega), and between Petaluma and Two Rock. Somewhat poorly drained, nearly level to gently sloping, fine sandy loams to clay loams. Principal use for dry farming or irrigated pastures and hay.
Yolo-Cortina-Pleasanton	Occur along the Russian River north of Healdsburg, west of Healdsburg, and along some creek valleys near the Sonoma-Napa county line. Well drained to excessively drained, nearly level to moderately sloping, very gravelly sandy loams to clay loams. Used mainly for pasture. Generally excellent farming soils capable of supporting grapes, row crops, orchards, or pasture.
Spreckels-Felta	Occur in the foothills in the east central portion of Sonoma County. Well drained, gently sloping to very steep, very gravelly loams to clay loams. Used as range and pasture land.
Yorkville-Suther	Occur in the foothills of the Mayacmas and other mountains of the Coast Ranges in the northern part of Sonoma County. Moderately well drained, moderately to very steeply sloping loams and clay loams. Used primarily for pasture and range.
Gounding-Tommes-Guenoc	Occur along the Russian River east of the Mayacmas and throughout the Sonoma Mountains. Well drained, gently to very steeply sloping clay loams. Used mainly for range, pasture, and watershed.
Kidd-Forward-Cohasset	Occur along the Sonoma-Napa county line. Excessively drained to well drained, moderately sloping to very steep, gravelly and stony loams. Used for range, watershed, and some recreation and timber.
Los Gatos-Henneke-Maymen	Occur in the Mayacmas Mountains in the northeast corner of Sonoma County. Well drained to excessively drained, moderately to very steeply sloping loams, gravelly loams, and gravelly sandy loams. Used primarily as watershed and for wildlife habitat.

Table 4.3-3

Soil Associations

Soil Association	Description
Hugo-Josephine-Laughlin	Occupy about one-third of Sonoma County, occurring in the Mayacmas and throughout the ridges of the Coast Ranges from Sebastopol to the Sonoma-Mendocino county line. Well drained, gently to very steeply sloping gravelly loams and loams. Used for commercial timber production as well as pasture and range for sheep.
Steinbeck-Los Osos	Occur in the southwestern portion of Sonoma County. Moderately drained to well drained, gently sloping to steep loams and clay loams. Used mainly for range and pasture.
Goldridge-Cotati-Sebastopol	Occur in the southwestern part of Sonoma County. Moderately well drained to well drained, gently sloping fine sandy loams and sandy loams. Primary use is for apple orchards.
Kneeland-Rohnerville-Kinman	Occur along the Pacific Coast north of Bodega Bay. Well drained to moderately well drained, nearly level to steeply sloping loams and clay loams. Primarily used as range or pasture.
Empire-Caspar-Mendocino	Occur along the South Fork Gualala River, in the northwest corner of Sonoma County. Well drained to moderately well drained, strongly to steeply sloping sandy loams and sandy clay loams. Used mainly as timberland.

Source: U.S. Soil Conservation Service, 1972

Table 4.3-4

Soil Association Characteristics

Soil Association	Percolation Rate[1]	Expansion Potential[2]	Erosion Hazard[2]	Liquefaction Potential[2]	Soil Strength[3]
Clear Lake Reyes	S	H	L	VL	P
Haire-Diablo	S	M-H	M-H	VL-L	P-F
Huichica-Wright-Zamora	VS-MS	H	L-M	VL-L	F-P
Pajaro	MS	L	L	M	F
Yolo-Cortina-Pleasanton	MS-VR	L	L	L-M	F-G
Spreckels-Felta	S-M	L-H	H	VL-L	F

Table 4.3-4

Soil Association Characteristics

Soil Association	Percolation Rate[1]	Expansion Potential[2]	Erosion Hazard[2]	Liquefaction Potential[2]	Soil Strength[3]
Yorkville-Suther	VS-S	H	H	VL-L	F-P
Gounding-Tommes-Guenoc	M	M	H	VL-L	F-P
Kidd-Forward-Cohasset	M-R	L-M	H-VH	L	F
Los Gatos-Henneke-Maymen	MS-M	L-M	H-VH	L-M	F
Hugo-Josephine-Laughlin	M	M-L	H-VH	L	F
Steinbeck-Los Osos	M-S	M-H	H-M	VL	F-P
Goldridge-Cotati-Sebastopol	S	M-L	H-M	VL-M	F-P
Kneeland-Rohnerville-Kinman	S-MR	L-H	M-H	VL-M	F-P
Empire-Caspar-Mendocino	M-MS	M	M	L-M	F

Source: U.S. Soil Conservation Service, 1972

1 VR = Very Rapid; R = Rapid; MR = Moderately Rapid; M= Moderate; MS = Moderately Slow; S = Slow; VS = Very Slow.

2 VH = Very High; H = High; M = Moderate; L = Low; VL = Very Low.

3 G = Good; F = Fair; P = Poor.

Soil Hazards

Soil permeability conditions affect suitability of the land for irrigation, for construction of dam embankments, or for lining reservoirs. Soils with very slow to moderate percolation rates (which dominate the Project area) have low to moderate permeability. Soils that have low permeability are potential sources of clay lining for ponds or the impervious core zone for dam embankments.

Expansiveness, or the potential to swell and shrink with repeated cycles of wetting and drying, is another common characteristic of many of the soils in the Project area. Expansiveness can cause distress to structure foundations. Expansive soils tend to be weak and compressible, and they may not provide adequate support for

foundations unless they are specially treated. Sometimes they must be removed entirely and replaced with engineered backfill. If left in place, these weak soils can cause unacceptable amounts of settlement and may require special foundation designs.

Erosion potential is variable throughout the Project region. Silty soils are generally readily erodible whereas sandier soils are less susceptible to erosion. Excessive erosion in the vicinity of building and pipeline structures can result in the loss of foundation support. Excessive erosion could also contribute to reservoir siltation (i.e., the reservoir filling up with silt).

Regulatory Framework

Building Permits

Project structures would be constructed in numerous local jurisdictions. Each city and county has adopted building codes, typically based on the Uniform Building Code, that specify design and construction standards and require that an approved building permit be obtained prior to construction. Local jurisdictions also require that a building inspector review plans and inspect the construction site and grant final approval upon completion of construction. Building permits would be required for pump stations. Dam construction requires special permits issued by the state, discussed below.

Grading Ordinance

Construction or installation of project facilities would require grading of land located in numerous jurisdictions. Some cities and counties in the study area have adopted grading ordinances to regulate grading and to minimize environmental impacts associated with construction grading. Grading ordinances typically require setbacks from property lines, erosion and sediment control, soil stockpile management methods, and inspection procedures. A grading permit may be required, depending on local jurisdiction ordinance specifications, for pipeline installation, road construction, transmission line construction, or other earth works.

National Pollutant Discharge Elimination System Permit

The federal Clean Water Act regulates the discharge of stormwater from construction sites. The State Water Resources Control Board has obtained a General Permit (No. CAS000002) for discharge of stormwater runoff associated with construction activities. Construction activities include clearing, grading, or excavation that results in soil disturbance of at least five acres of total land area. Construction activities that result in soil disturbance of less than five acres require a permit if the construction activity is part of a larger common plan of development. Therefore, the owner of the land where construction would occur is responsible for obtaining coverage under the state-wide General Permit and is

required to file a Notice of Intent for each construction activity prior to commencement of construction.

The General Permit requires development and implementation of a Storm Water Pollution Prevention Plan and identification of a monitoring program and reporting requirements. Sediment control measures that shall be included in the General Permit (from State Water Resources Control Board Fact Sheet) are as follows:

a) A description of soil stabilization practices. These practices shall be designed to preserve existing vegetation where feasible and to revegetate open areas as soon as feasible after grading or construction. In developing these practices, the discharger shall consider: temporary seeding, permanent seeding, mulching, sod stabilization, vegetation buffer strips, protection of trees, or other soil stabilization practices. At a minimum, the operator must implement these practices on all disturbed areas during the rainy season.

b) A description or illustration of control practices which, to the extent feasible, will prevent a net increase of sediment load in stormwater discharge. In developing control practices, the discharger shall consider a full range of erosion and sediment controls such as detention basins, straw bale dikes, silt fences, earth dikes, brush barriers, velocity dissipation devices, drainage swales, check dams, subsurface drain, pipe slope drain, level spreaders, storm drain inlet protection, rock outlet protection, sediment traps, temporary sediment basins, or other controls. At a minimum, sandbag dikes, silt fences, straw bale dikes, or equivalent practices are required for all significant sideslope and downslope boundaries of the construction area, The discharger must consider site-specific and seasonal conditions when designing the control practices.

c) Control practices to reduce the tracking of sediment onto public or private roads. These public and private roads shall be inspected and cleaned as necessary.

d) Control practices to reduce wind erosion.

Division of Safety of Dams

Since 1929, the State of California has supervised the construction and operation of dams to prevent failure to safeguard life and protect property. The California Department of Water Resources, Division of Safety of Dams supervises the construction, enlargement, alteration, repair, maintenance, operation, and removal of dams and reservoirs. The Division of Safety of Dams has jurisdiction over all non-U.S. owned dams in the State that are 25 feet or higher (regardless of storage capacity) and dams with a storage capacity of 50 acre-feet of water or greater

(regardless of height). Dams six feet or less in height (regardless of storage capacity) or dams with a storage capacity of 15 acre-feet or less (regardless of height) are not under the Division's jurisdiction (California Water Code, Division 3).

When reviewing permit applications the Division of Safety of Dams evaluates the safety of dams and reservoirs by assessing the potential for seepage, earth movement, and other conditions that may occur in the vicinity of a dam or reservoir. The Division requires that data concerning subsoil, foundation conditions, availability of construction materials, and geologic hazards be gathered to review the design, construction, and operation of dams and reservoirs. Investigations usually include exploratory pits, trenches, drilling, coring, geophysical surveys, tests to determine leakage rates, and physical tests to measure properties of foundation materials. Staff at the Division of Safety of Dams performs an independent evaluation of the dam engineer's design to ensure that the design meets or exceeds required standards. Special conditions may be attached to the Division of Safety of Dams permit approval, and design and construction plans may be modified by the Division at any time after approval to insure safety.

During the construction or repair of any dam or reservoir, the Division of Safety of Dams is required to make continuous and periodic inspections to verify that construction is proceeding in accordance with approved plans.[8] No foundations or abutments may be covered until the Division's field engineer has inspected and approved them. The Division of Safety of Dams permit approval may be revoked whenever the dam or reservoir constitutes a danger to life and property.

A discussion of historical dam failure, dam surveillance and monitoring, and evaluation of dam inundation are provided in Section 4.19, Inundation from Dam Failure.

Geology, Soils, and Seismicity Goals, Objectives, and Policies

Table 4.3-5 identifies goals, objectives, and policies which provide guidance for development in relation to geology, soils and seismicity in the Project area. The table also indicates which evaluation criteria in the Geology, Soils, and Seismicity Section are responsive to each set of policies.

[8] Under the police power of the State representatives of the Division of Safety of Dams may enter private property to make investigations or inspections.

Table 4.3-5

General Plan Goals, Objectives, and Policies - Geology, Soils, and Seismicity

Adopted Plan Document	Document Section	Document Numeric Reference	Policy	Relevant Evaluation Criteria[1]
Sonoma County General Plan	Public Safety Element	Goal PS-1 Objective PS-1.1 Objective PS-1.2 Policy PS-1f	Prevent unnecessary exposure of people and property to risks from earthquakes, landslides and other geologic hazards and regulate new development to reduce risks from known geologic hazards to acceptable levels	1-8
Sonoma County General Plan	Public Safety Element	Policy PS-1j	Encourage strong enforcement of state seismic safety requirements for dams	5
Sonoma County General Plan	Public Safety Element	Policy PS-1k	Incorporate measures to mitigate identified geologic hazards to acceptable levels	1-8
Santa Rosa General Plan	Noise and Safety Element	Goal S-2 Objective S-2b	Minimize potential earthquake impacts and assure provisions of the Alquist-Priolo Special Studies Zone Act are met	2,3,4,5
Santa Rosa General Plan	Noise and Safety Element	Goal S-3 Objective S-3a	Identify and mitigate geologic and soils hazards	1-8
Petaluma General Plan	Community Health and Safety Element	Objective (h) Policy 14 Policy 15 Policy 16	Minimize injury and property damage resulting from landslides and mass movements including areas prone to slope instability erosion and mass movement	1,3,6
Petaluma General Plan	Community Health and Safety Element	Objective (g) Policy 11 Policy 13	Minimize risks associated with seismic activity and avoid placement of critical facilities in areas prone to ground failure during an earthquake	2,3,4,5
Petaluma General Plan	Community Health and Safety Element	Objective (t)	Decrease the loss of topsoil and the deterioration of water quality that results from erosion and sedimentation	6
Sebastopol General Plan	Conservation, Open Space and Parks Element	Goal 4 Policy 10 Program 10.1	Protect and preserve soil as a natural resource and control soil erosion	6

Table 4.3-5

General Plan Goals, Objectives, and Policies - Geology, Soils, and Seismicity

Adopted Plan Document	Document Section	Document Numeric Reference	Policy	Relevant Evaluation Criteria[1]
Sebastopol General Plan	Safety Element	Goal 2 Policy 3 Program 3.1	Minimize risk resulting from slope instability, unstable land areas susceptible to liquefaction and settlement or containing expansive soils	1,3,7
Windsor General Plan	Environmental Resources Element	Policy C1.6	Require that development minimize discharge of sediments into waterways	6

Source: Harland Bartholomew and Associates, Inc., 1995

1. Evaluation Criteria can be found in Table 4.3-6.

EVALUATION CRITERIA WITH POINT OF SIGNIFICANCE

According to the CEQA Guidelines, exposure of people or structures to major geologic hazards is considered a significant impact. Geologic hazards within the Project area include slope instability, strong ground shaking, fault rupture, liquefaction, and other processes that could affect soil stability.

Table 4.3-6

Evaluation Criteria with Point of Significance

Evaluation Criteria	As Measured by	Point of Significance	Justification
1. Will Project facilities be located within an area of unstable slope conditions?	Geotechnical assessment of landslide risk potential	Overall rating of Moderate to High	The rating system takes into consideration slope gradient, existing slope instability, rock types and geologic structure. In general, steeper slopes underlain by the weak Petaluma Formation claystone are less stable than gentler slopes and sites underlain by Wilson Grove and Franciscan Complex rocks. Landslides and other slope failure could occur in areas with Moderate to High risk. "Low" risk areas are expected to have stable slope conditions.

Table 4.3-6

Evaluation Criteria with Point of Significance

Evaluation Criteria	As Measured by	Point of Significance	Justification
2. Will Project facilities be subject to ground rupture due to location near a surface trace of an active fault?	Location of facilities within an Alquist-Priolo earthquake fault zone	Any portion of facilities within zone	Earthquake fault zones are established under the Alquist-Priolo earthquake fault zone Act by the California Division of Mines and Geology (CDMG) to regulate development near active faults to mitigate the hazard of surface rupture. The Act applies only to structures for human occupancy but the zones accurately delineate areas at greatest risk for surface fault rupture.
3. Will Project facilities be located in areas with soils and groundwater conditions that are susceptible to liquefaction during an earthquake?	CDMG rating of potential for liquefaction or more detailed mapping, where available	A rating of High for liquefaction for project facilities except irrigation pipes	Certain soil types, especially fine sandy soils, underlain by shallow groundwater, are prone to liquefaction. The Division of Mines and Geology has identified areas where soil properties are highly susceptible to liquefaction. Project facilities in these areas would be vulnerable to damage from liquefaction.
4. Will the Project induce seismicity?	Project induced ground shaking intensity	Ground shaking effects of Modified Mercalli[9] intensity V or greater (Table 4.3-1) decreasing in recurrence interval by 50% or more for earthquakes with existing recurrences intervals of greater than one year	Earthquakes that produce ground shaking intensity of Modified Mercalli IV (generally corresponds to a magnitude 3 earthquake within an epicentral distance of several miles) are not generally associated with damage to people or property. CEQA defines damage to people or property as a significant effect.

[9] Modified Mercalli intensity scale is used because it describes the groundshaking affects of an earthquake at a given location. Scales, such as the Richter scale, based on Magnitude measures total energy released in an earthquake and does not account for distance from the epicenter or soil type.

Table 4.3-6

Evaluation Criteria with Point of Significance

Evaluation Criteria	As Measured by	Point of Significance	Justification
5. Will earthquake-induced strong ground shaking damage Project facilities?	Structural design and construction not in conformance with requirements of the Division of Safety of Dam or applicable building codes (refer to text).	Construction not in conformance with requirements of the Division of Safety of Dam or applicable building codes.	Division of Safety of Dam regulations and local building codes.
6. Will construction of the Project cause off-site water-related erosion?	Construction activities not in compliance with requirements of the project National Pollutant Discharge Elimination System Permit (NPDES), Division of Safety of Dams regulations, or building and grading codes.	Construction not in compliance with NPDES, Division of Safety of Dams, or building and grading codes.	Clean Water Act regulations, Division of Safety of Dam regulations, and local building or grading ordinances (refer to text).
7. Will Project facilities be exposed to damage due to expansive soils?	Shrink-swell potential as rated in Sonoma County Soil Survey (Soil Conservation Service 1972)	A rating of Moderate to High for shrink-swell potential for project facilities except irrigation pipes	The USDA Soil Conservation Service (SCS) indicates that: "If the shrink-swell potential is rated moderate to very high, shrinking and swelling can damage buildings, roads, and other structures."
8. Will Project facilities be exposed to damage due to construction on corrosive soils?	Corrosion potential as rated in Sonoma County Soil Survey (SCS 1972)	A rating of High for corrosion potential	The SCS indicates that soils with High corrosion can damage uncoated steel and concrete by chemical actions that dissolve and weaken the material.

Source: Parsons Engineering Science, Inc. 1996

Methodology

This impacts analysis is based on a review of relevant geologic literature and review and summary of technical reports prepared for evaluation of Project alternatives. The following technical reports were used:

- *Geotechnical Assessment of Alternative Reservoir Sites and Pipeline Routes* (Rust Environment and Infrastructure, Inc. 1996); and
- *Induced Seismicity Study Geysers Recharge Alternative* (Greensfelder and Parsons Engineering Science, Inc. 1996).

ENVIRONMENTAL CONSEQUENCES (IMPACTS) AND MITIGATION MEASURES

No Action (No Project) Alternative

Impact: 3.1.1-8. Will the No Action Alternative have geologic impacts based on evaluation criteria 1 through 8?

Analysis: *No Impact, Alternative 1.*

There are no geologic hazards or impacts of the No Action Alternative because there will be no construction or new impacts from operation.

Mitigation: No mitigation is needed.

Headworks Expansion Component

Table 4.3-7

Geology Impacts by Component - Headworks Expansion

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
3.2.1. Will the headworks expansion component be located within an area of unstable slope conditions?	Overall rating of Moderate to High	None	P	=
3.2.2. Will the headworks expansion component be subject to ground rupture due to location near a surface trace of an active fault?	Any portion of facilities within an Alquist-Priolo earthquake fault zone	No	P	=
3.2.3. Will the headworks expansion component be located in areas with soils and groundwater conditions that are susceptible to liquefaction during an earthquake?	A rating of High for liquefaction	Moderate to Low	P	O

Table 4.3-7

Geology Impacts by Component - Headworks Expansion

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
3.2.4. Will the headworks expansion component induce seismicity?	Effects of Modified Mercalli V or greater decreasing in recurrence interval by 50% or more for earthquakes with existing recurrence intervals of greater than one year	None	P	==
3.2.5. Will earthquake-induced strong ground shaking damage the pipeline component?	Construction not in conformance with requirements of the Division of Safety of Dams or applicable building codes	None	P	==
3.2.6. Will construction of the headworks expansion component cause off-site water-related soil erosion?	Construction activities not in compliance with requirements of the project NPDES permit, Division of Safety of Dams regulations or building and grading codes	None	C	==
3.2.7. Will the headworks expansion component be exposed to damage due to expansive soils?	A rating of Moderate to High for shrink-swell potential	None	P	==
3.2.8. Will the headworks expansion component be exposed to damage due to construction on corrosive soils?	A rating of High for corrosion potential	None	P	==

Source: Parsons Engineering Science, Inc. 1996

Notes:

1. Type of Impact:
   - C Construction
   - P Permanent

2. Level of Significance:
   - == No impact
   - ❍ Less than significant impact; no mitigation proposed

Impact: **3.2.1, 2, 4-8. Will the headworks expansion component have geologic impacts based on criteria 1, 2, and 4-8?**

Analysis: *No Impact; All Alternatives.*

The new pumps will be installed in an existing building located on flat ground where there is no risk of slope instability.

The headworks location is not within an Alquist-Priolo earthquake fault zone.

The headworks expansion involves no injection of water into the earth or other process by which seismicity could be induced.

Construction of the new influent pumps at the headworks will conform with applicable building code; would not involve grading, and will not require new construction in soils.

Alternative 1 does not have a headworks component.

Mitigation: No mitigation is needed.

Impact: **3.2.3. Will the headworks expansion component be located in areas with soils and groundwater conditions that are susceptible to liquefaction?**

Analysis: *Less than Significant; Alternatives 2, 3, 4, and 5.*

The Laguna Plant is located in an area that is mapped as having a high potential for liquefaction (California Division of Mines and Geology, 1994). However, the pumps would be installed in a building with a deep foundation, about 45 to 50 feet below the ground surface, which is founded in clay material that is not susceptible to liquefaction (Harding-Lawson Associates, 1974).

No Impact, Alternative 1.

This alternative does not have a headworks component.

Mitigation: No mitigation is proposed.

Urban Irrigation Component

Impact: **3.3.1-8. Will the urban irrigation component have geologic impacts based on evaluation criteria 1 through 8?**

Analysis: *No Impact; All Alternatives.*

Because the urban irrigation component involves no construction, only replacement of the existing source of water with reclaimed water, there are no geologic hazards or impacts.

Mitigation: No mitigation is needed.

Table 4.3-8

Geology Impacts by Component - Pipelines

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
3.4.1. Will the pipeline component be located within an area of unstable slope conditions?	Overall rating of Moderate to High			
• Urban Irrigation (Bennett Valley only) Pipelines		High	P	⊙
• South County pipelines		Low	P	○
• West County pipelines • (including Sebastopol)		Low	P	○
• Geysers pipeline		High	P	●
• Discharge pipeline		Low	P	○
3.4.2. Will the pipeline component be subject to ground rupture due to location near a surface trace of an active fault?	Any portion of facilities within an Alquist-Priolo earthquake fault zone			
• Urban irrigation pipelines		Yes	P	●
• South County pipelines		No	P	=
• West County pipelines • (including Sebastopol)		No	P	=
• Geysers pipeline		Yes	P	●
• Discharge pipeline		No	P	=
3.4.3. Will the pipeline component be located in areas with soils and groundwater conditions that are susceptible to liquefaction during an earthquake?	A rating of High for liquefaction	High	P	⊙
3.4.4. Will the pipeline component induce seismicity?	Effects of Modified Mercalli V or greater decreasing in recurrence interval by 50% or more for earthquakes with existing recurrences intervals of greater than one year	None	P	=

Table 4.3-8

Geology Impacts by Component - Pipelines

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
3.4.5. Will earthquake-induced strong ground shaking damage project facilities?	Construction not in conformance with requirements of the Division of Safety of Dams or applicable building code	None	P	=
3.4.6. Will construction of the Project cause off-site water-related soil erosion?	Construction activities not in compliance with requirements of the project NPDES permit, Division of Safety of Dams regulations or building and grading codes	None	C	=
3.4.7. Will the pipeline component be exposed to damage due to expansive soils?	A rating of Moderate to High for shrink-swell potential			
• Discharge		Low	P	○
• All alternatives except Discharge		Moderate to High	P	⊙
3.4.8. Will the pipeline component be exposed to damage due to construction on corrosive soils?	A rating of High for corrosion potential			
• Pipelines to bay flats and Lakeville agricultural irrigation areas		High	P	⊙
• All other pipelines		Moderate to Low	P	○

Source: Parsons Engineering Science, Inc., 1996

Notes:	1. Type of Impact:		2. Level of Significance:
C	Construction	=	No impact
P	Permanent	○	Less than significant impact; no mitigation proposed
		⊙	Significant impact before mitigation; less than significant impact after mitigation
		●	Significant impact before and after mitigation

Impact: **3.4.1. Will the pipeline component be located within an area of unstable slope conditions?**

Analysis: *Significant; Alternative 2,3 and 4.*

The segment of the geysers pipeline along Pine Flat Road will traverse areas of unstable slopes in steep terrain. Based on the occurrence of unstable bedrock and existing landslides along the northern geysers pipeline alignment, the area is considered to have a high potential for slope instability. Slope instability is a major geologic hazard along this portion of the alignment and could result in pipeline damage and/or rupture (Rust Environment and Infrastructure, Inc. 1995). Breakage of the pipe could result in release of reclaimed water and could cause substantial erosion and roadway damage at the discharge points.

The geysers pipeline is a large, 42-inch pressurized line (600 pounds per square inch). Because of its relatively remote location, prompt response to pipe failure will be difficult. Manual isolation valves are located at 10,000-foot intervals along the geysers pipeline. These valves will allow the isolation of 10,000-foot sections of the pipe to allow repairs to be made. However, in the event of a major break, it is unlikely that staff from the Utilities Department could travel to the pipeline and manually close the valve before all of the water had drained from the pipe. Intermediate pump stations along the alignment will prevent all of the water in the pipeline from being released if rupture were to occur. Placement of the geysers transmission pipeline along Pine Flat Road could result in significant damage to the pipeline because this portion of the alignment traverses areas that have a high potential for slope failure.

Bennett Valley Urban Irrigation Pipeline. The southeastern-most segment of the Bennett Valley urban irrigation pipeline is located in an area of unstable slope conditions (Rust 1995).

The transmission and distribution pipelines for both South County and West County alternatives are not located in areas of moderate to high risk of slope instability.

Less than Significant; Alternative 5A.

The discharge pipeline is in gently sloping terrain where slope stability would not be a concern.

No Impact; Alternative 1 and 5B.

These alternatives do not have a pipeline component.

Mitigation: *Alternatives 2, 3, and 4.*

2.3.4. Slope Stabilization Design.

2.3.7. Slope Monitoring and Response System.

2.3.8. Earthquake Preparedness and Emergency Response Plan.

Alternatives 1 and 5. No mitigation is proposed.

After Mitigation: *Less than Significant after Mitigation; Alternatives 2 and 3.*

Significant after Mitigation; Alternative 4.

Because of the extensive distribution of landsliding and potentially unstable rock units along Pine Flat Road it is unlikely that slope instability impacts can be completely mitigated. Engineering measures will be applicable only in localized areas where landslide deposits are shallow and of limited extent. Slope instability along the Pine Flat Road segment of the geysers pipeline alignment could not be feasibly mitigated and Project facilities will be at risk of damage or failure throughout the life of the Project.

Slope stability monitoring will not prevent impacts from occurring but will provide advanced warning so some slope stabilization measures could be implemented or repairs could be made to prevent larger-scale damage to the pipeline system.

Impact: **3.4.2. Will the pipeline component be subject to ground rupture due to location near a surface trace of an active fault?**

Analysis: *Significant; Alternative 2, 3, and 4.*

The geysers transmission pipeline crosses both the Healdsburg-Rodgers Creek and Maacama Faults. Portions of the geysers 42-inch pipeline are located within Alquist-Priolo earthquake fault zones. The pipeline route crosses the Healdsburg Fault at Chalk Hill Road and the Maacama Fault at Pine Flat Road.

Surface fault rupture associated with seismic activity on the Healdsburg-Rodgers Creek and Maacama faults could result in pipeline damage and/or rupture. A large earthquake on the Rodgers Creek Fault will result in an estimated maximum surface displacement of six feet, although the estimated average surface displacement is approximately three feet (California Division of Mines and Geology 1994). Pipe rupture could result in release of reclaimed water and could cause substantial erosion at the discharge point. Pipe rupture and washout will probably damage Pine Flat Road at the rupture location because pipelines will be installed in roadways.

The geysers pipeline is a large, 42-inch pressurized line (600 pounds per square inch). Because of its relatively remote location prompt response to pipe failure would be difficult. Intermediate pump stations along the alignment will prevent all of the water in the pipeline from being released if rupture were to occur. The maximum volume of water that could be

spilled from the geysers pipeline in the event of surface rupture on the Maacama Fault would be 1.7 million gallons.

Portions of the Fountaingrove and Bennett Valley 12-inch urban irrigation pipelines are within the Alquist-Priolo earthquake fault zone for the active Healdsburg-Rodgers Creek Fault. One fault crossing occurs at the Fountaingrove Parkway just west of the Fountaingrove Golf Course. Three sections of the Bennett Valley pipeline are within the Alquist-Priolo earthquake fault zone at a location about 1,000 feet east of the County Fairgrounds.

Urban irrigation pipelines have smaller diameters (12 to 18 inches) and lower pressure (about 100 pounds per square inch) than the geysers pipeline. The installation of isolation valves, the accessibility of pipelines, and anticipated rapid response to pipe rupture will limit spills to an estimated 100,000 gallons of water (approximately the amount contained in a standard 75-foot swimming pool) to be released in the event of surface fault rupture.

Damage to pipelines could occur throughout coastal California in the event of a large earthquake. The existing system, as well as components proposed by this Project, will be vulnerable to damage. Damage to pipelines is an unavoidable consequence of construction and operation of a wastewater system in a seismically active area. Though earthquake damage is a concern throughout California, significant impacts are identified for the following pipelines due to their proximity to faults:

- Urban irrigation pipeline to the Fountaingrove area crosses the Healdsburg-Rodgers Fault.
- Urban irrigation pipeline to the Bennett Valley area crosses the Healdsburg-Rodgers Creek Fault.
- Geysers transmission pipeline crosses the Maacama Fault and the Healdsburg Fault.

No Impact; Alternatives 1 and 5.

The Russian River discharge pipeline is not within an Alquist-Priolo earthquake fault zone. Alternatives 1 and 5B do not have a pipeline component.

Mitigation: *Alternatives 2, 3, and 4.*

2.3.8. Earthquake Preparedness and Emergency Response Plan.

Alternatives 1 and 5. No mitigation is proposed.

After Mitigation: *Significant after Mitigation; Alternatives 2, 3, and 4.*

After implementation of this mitigation measure potentially significant impacts could still result from surface fault rupture during a large earthquake such as the maximum credible earthquake on the Healdsburg-Rodgers Creek or Maacama Faults. Mitigation will reduce effects of a pipeline break but could not prevent pipe rupture.

Impact: **3.4.3. Will the pipeline component be located in areas with soils and groundwater conditions that are susceptible to liquefaction during an earthquake?**

Analysis: *Significant; Alternatives 2, 3, 4 and 5A.*

Pipelines installed in areas underlain by alluvial soils where shallow groundwater is present will be vulnerable to damage caused by liquefaction. Liquefaction can cause pipes to crack and/or rupture and may disrupt the alignment of pipes. Pipelines throughout the Project area, particularly along the San Pablo Bay area, the Laguna de Santa Rosa, and the Russian River and Alexander valleys, could be damaged if liquefaction were to occur during a large earthquake.

The Earthquake Planning Scenario for a Major Earthquake on the Rodgers Creek Fault in the Northern San Francisco Bay Area (California Division of Mines and Geology 1994) was reviewed to determine potential impacts to Project pipelines. Effects on existing pipelines were evaluated as a method for projecting effects on proposed pipelines. The report indicates that existing main sewage lines of the Subregional System will be interrupted with breaks where they cross areas of potential liquefaction north of the Laguna Plant. Thus, proposed transmission pipelines that will be installed in the vicinity of the Laguna Plant to connect various project elements to the main plant will be vulnerable to damage from liquefaction. An estimated thirty days will be needed to restore service (California Division of Mines and Geology 1994).

No Impact; Alternatives 1 and 5B.

These alternatives do not have a pipeline component.

Mitigation: *Alternatives 2, 3, 4, and 5A.*

2.3.5. Liquefaction Stabilization Design.

Alternatives 1 and 5B. No mitigation is needed.

After Mitigation: *Less than Significant after Mitigation; Alternatives 2, 3, 4, and 5A.*

This measure avoids liquefaction hazards by removing liquefaction-prone soils, de-watering, or providing foundations at a depth where liquefaction is not expected to occur.

Impact: **3.4.4-6. Will the pipeline component have geologic impacts based on criteria 4, 5, and 6?**

Analysis: *No Impact; All Alternatives.*

Pipeline construction and operation will not involve direct injection of water, thus, would not induce seismicity.

Design and construction will be in conformance with applicable building codes, National Pollutant Discharge Elimination System Permit, and grading ordinances. These measures will insure that strong ground shaking during an earthquake and off-site erosion during construction would not be significant.

Alternatives 1 and 5B do not have a pipeline component.

Mitigation: No mitigation is needed.

Impact: **3.4.7. Will the pipeline component be exposed to damage due to expansive soils?**

Analysis: *Significant; Alternatives 2, 3, and 4.*

The majority of soils within the study area contain clay and have moderate to high shrink-swell potential (Soil Conservation Service 1972). Highly expansive soils are particularly common in the South County. Soils that have a high clay content may expand when wet and contract when dry. These changes in soil moisture content may damage pipelines if not properly managed during construction.

Less than Significant; Alternative 5A.

Soils along the route of the discharge pipeline are rated as Low for shrink-swell potential, and damage due to expansive soils is therefore considered less than significant.

No Impact; Alternatives 1 and 5B.

These alternatives do not have a pipeline component.

Mitigation: *Alternatives 2, 3, and 4.*

2.4.3. Standard Engineering Methods for Expansive Soils.

Alternative 1 and 5. No mitigation is proposed.

After Mitigation: *Less than Significant after Mitigation; Alternatives 2, 3, and 4.*

This measure avoids impacts by removing the expansive soils, or remediates the situation by changing the composition of the soil, or avoids impacts by providing a deeper foundation or footing.

Impact: **3.4.8. Will the pipeline component be exposed to damage due to corrosive soils?**

Analysis: *Significant; Alternative 2.*

Pipelines to the bay flats and Lakeville agricultural irrigation areas will be constructed in soils with a high rating for corrosivity. They could be exposed to potentially significant damage due to highly corrosive Reyes soils that could damage steel or concrete pipelines and other structures.

Less than Significant; Alternative 3, 4, and 5A.

These pipelines will be constructed in soils with a Low or Moderate rating for corrosivity and potential damage is considered less than significant.

No Impact; Alternatives 1 and 5B.

These alternatives do not have a pipeline component.

Mitigation: *Alternative 2.*

2.3.6. Standard Engineering Methods for Corrosive Soils.

Alternatives 1, 3, 4, and 5. No mitigation is proposed.

After Mitigation: *Less than Significant after Mitigation; Alternative 2.*

This measure avoids the corrosive soil problem by changing the type of pipe which will be used in the Project.

Storage Reservoir Component

Reservoirs will be exposed to geologic and other hazards. Many of these hazards would be mitigated by the California Division of Safety of Dams permitting procedure. Dam and reservoir design, plan review, and construction monitoring are regulated by the Division of Safety of Dams. Reservoirs will be designed and constructed in accordance with Division of Safety of Dams requirements and the Division will review all design and construction methods. State law requires that the Division of Safety of Dams issue a permit for a dam and reservoir of the type proposed by this project prior to construction. Additional reservoir mitigation measures are discussed in this section and Chapter 2.

Table 4.3-9

Geology Impacts by Component - Storage Reservoirs

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Signifi-cance[2]
3.5.1. Will the storage reservoir component be located within an area of unstable slope conditions?	Overall rating of Moderate to High			
• Tolay Extended, Tolay Confined, Sears Point		Moderate	P, O&M	●
• Adobe Road, Lakeville Hillside		High	P, O&M	●
• West County reservoirs		Low	P, O&M	❍
3.5.2. Will the storage reservoir component be subject to ground rupture due to location near a surface trace of an active fault?	Any portion of facilities within an Alquist-Priolo earthquake fault zone	None	P	=
3.5.3. Will the storage reservoir component be located in areas with soils and groundwater conditions that are susceptible to liquefaction during an earthquake?	A rating of High for liquefaction	Moderate to Low	P	❍
3.5.4. Will the storage reservoir component induce seismicity?	Effects of Modified Mercalli V or greater decreasing in recurrence interval by 50% or more for earthquakes with existing recurrences intervals of greater than one year	None	P	=
3.5.5. Will earthquake-induced strong ground shaking damage storage reservoir component?	Construction not in conformance with requirements of the Division of Safety of Dams or applicable building codes	None	P	=
3.5.6. Will construction of the storage reservoir component cause off-site water-related soil erosion?	Construction activities not in compliance with requirements of the project NPDES permit, Division of Safety of Dams regulations or building and grading codes	None	C	=

Table 4.3-9

Geology Impacts by Component - Storage Reservoirs

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
3.5.7. Will the storage reservoir component be exposed to damage due to expansive soils?	A rating of Moderate to High for shrink-swell potential			
• South County reservoir sites		High	P	⊙
• West County reservoir sites		Low	P	○
3.5.8. The storage reservoir component may be exposed to damage due to construction on corrosive soils.	A rating of High for corrosion potential	Moderate to Low	P	○

Source: Parsons Engineering Science, Inc. 1996

Notes:

1. Type of Impact:
   - C — Construction
   - O&M — Operation and Maintenance
   - P — Permanent

2. Level of Significance:
   - = No impact
   - ○ Less than significant impact; no mitigation proposed
   - ⊙ Significant impact before mitigation; less than significant impact after mitigation
   - ● Significant impact before and after mitigation

Impact: **3.5.1. Will the storage reservoir component be located within an area of unstable slope conditions?**

Analysis: In addition to existing geologic conditions which may create instability for the dams, operation of the storage reservoir may create additional tendencies toward instability. The reservoir operation plan specifies that reservoirs will store water during the wet season. Water will be drained and pumped into the irrigation distribution system during the dry seasons. Seasonal reservoir management results in fluctuations in water levels. Alternating wetting and drying of reservoir slope material can reactivate existing landslides or create new landslides.

Significant; Alternative 2.

All South County reservoir sites are underlain by the Petaluma Formation, which is susceptible to slope failure. Slope failure at proposed South County reservoir sites with moderate to high slope instability hazards could result in damage to Project structures (such as diversion channels) or

accelerated siltation. Slope instability at the Adobe Road and Lakeville Hillside reservoir sites will result in substantial accelerated siltation in the reservoir. Landsliding at the Adobe Road site could generate an estimated 100,000 to 200,000 cubic yards of silt that will enter the reservoir each year. Landsliding at the Lakeville Hillside site could generate an estimated 50,000 to 100,000 cubic yards of silt each year. Because there are fewer landslides and more gentle topography at Sears Point and Tolay than at the Adobe Road and Lakeville Hillside sites, these sites have a slope stability rating of moderate instead of high. The geotechnical analysis has not quantified an annual siltation rate for these sites. The annual siltation rate at the Sears Point and Tolay reservoir sites will be less than those estimated for Adobe Road and Lakeville Hillside, but it would still be substantial. Slope instability at these sites would have a significant adverse impact on the project.

Siltation at Adobe Road and Lakeville Hillside sites will require dredging and removal of spoils. Section 4.11, Transportation, and Section 4.16, Public Services, Utilities, and Recreation, evaluate secondary impacts of removal and disposal of silt.

Less than Significant; Alternative 3.

Slope instability at all West County reservoir sites is rated as low and considered be a less than significant hazard.

No Impact; Alternatives 1, 4, and 5.

These alternatives do not have a storage reservoir component.

Mitigation: *Alternative 2.*

2.3.4. Develop slope stabilization measures.

2.4.2. Remove weak surficial deposits from reservoir footprint.

Alternatives 1, 4, and 5. No mitigation is proposed.

After Mitigation: *Significant after Mitigation; Alternative 2.*

Removal of surficial deposits and implementation of slope stabilization measures will provide an adequate dam and reservoir foundation at all reservoir sites and substantially reduce the amount of land sliding at the reservoirs. However, some landsliding from the reservoir side slopes and associated siltation would continue throughout the life of the Project and will remain a significant impact of the Project. The amount of siltation resulting from landslides will decrease over the life of the Project.

Impact: 3.5.2. Will the storage reservoir component be subject to ground rupture due to location near a surface trace of an active fault?

Analysis: *No Impact; All Alternatives.*

None of the reservoir sites are located within an Alquist Priolo earthquake fault zone. The Tolay Creek dam site is located about one mile west of the Rodgers Creek Fault. Although the Tolay Creek Fault is not considered to be active, seismic activity on the Rodgers Creek Fault could be associated with sympathetic movement along the Tolay Fault. Therefore, the design of all embankments that are found across the Tolay Fault will consider the potential for some displacement (2 to 4 feet of displacement assumed). Design features will include the installation of a thick, plastic internal core to prevent rupture and resist cracking and a drainage zone downstream of the core zone designed to prevent piping of core material and yet accommodate large seepage flow rates (Rust Environment and Infrastructure, Inc. 1995).

Construction of all reservoirs will conform to requirements of the Division of Safety of Dams. With implementation of these design measures, reservoirs are expected to withstand strong ground shaking from earthquakes.

Alternatives 1, 4, and 5 do not have a storage reservoir component.

Mitigation: No mitigation is needed.

Impact: 3.5.3. Will the storage reservoir component be located in areas with soils and groundwater conditions that are susceptible to liquefaction during an earthquake?

Analysis: *Less than Significant; Alternatives 2 and 3.*

None of the reservoir sites are located in an area rated as High for liquefaction potential by the California Division of Mines and Geology. Ratings range from Low to Moderate, and therefore no significant hazard is expected due to liquefaction.

Reservoir emplacement may result in localized groundwater mounding in the vicinity of reservoir sites as discussed in Section 4.5, Groundwater. However, the extent of anticipated mounding is minimal and generally does not extend more than 500 feet downgradient of the dam. Surface soils in the vicinity of the reservoir sites are not granular and are not susceptible to liquefaction.

No Impact; Alternatives 1, 4, and 5.

These alternatives do not have storage reservoir component.

Mitigation: No mitigation is proposed.

Impact: 3.5.4. Will the storage reservoir component induce seismicity?

Analysis: *No Impact; All Alternatives*

Research, including studies of thousands of case histories, indicates that a few, very large, reservoirs have induced large earthquakes (greater than magnitude 5) due to the weight of the stored water. However, a reservoir water depth of a minimum of 260 feet is required to induce seismicity. Induced earthquakes large enough to be damaging have never been documented to occur in reservoirs with lesser water depths. Even smaller seismic events have been convincingly documented in a total of only 16 cases out of some 11,000 worldwide "large" dams (Allen 1982). Storage reservoirs of the size proposed by this project will not induce seismicity because the weight of the water is insufficient. The maximum height of water proposed at a reservoir site is 200 feet at the Two Rock site.

Mitigation: No mitigation is needed.

Impact 3.5.5. Will earthquake-induced strong ground shaking damage the storage reservoir component?

Analysis: *No Impact; All Alternatives*

Construction of all reservoirs will conform to requirements of the Division of Safety of Dams. With implementation of these design measures, reservoirs are expected to withstand strong ground shaking from earthquakes.

Mitigation: No mitigation is needed.

Impact: 3.5.6. Will storage reservoir construction cause off-site water-related soil erosion?

Analysis: *No Impact; All Alternatives.*

Design and construction of dams, reservoirs, diversion structures, spillways and other facilities will be in conformance with National Pollutant Discharge Elimination System Permit and will be governed by a Stormwater Pollution Prevention Plan which will contain an erosion and sediment control plan. The Stormwater Pollution Prevention Plan is presented in Section 2.2.10.

Alternatives 1, 4, and 5 do not have a storage reservoir component

Mitigation: No additional mitigation is needed.

Impact: 3.5.7. Will the storage reservoir component be exposed to damage due to expansive soils?

Analysis: *Significant; Alternative 2.*

South County reservoir sites are situated on soils with moderate to high shrink-swell potential.

Less than Significant; Alternative 3.

The West County reservoir sites are all situated on soils with low shrink-swell potential; expansive soils at these sites will be considered a less than significant hazard.

No Impact; Alternatives 1, 4, and 5.

These alternatives do not have a storage reservoir component.

Mitigation: *Alternative 2.*

2.4.2. Remove weak surficial deposits from reservoir footprint.

2.4. 3. Standard Engineering Methods for Expansive Soils.

Alternatives 1, 3, 4, and 5. No mitigation is proposed.

After Mitigation: *Less than Significant after Mitigation; Alternative 2.*

This measure avoids impacts by removing the expansion soils, or remediates the situation by changing the composition of the soil, or avoids impacts by providing a deeper foundation or footing.

Impact: 3.5.8. Will the storage reservoirs be exposed to damage due to corrosive soils?

Analysis: *Less than Significant; Alternatives 2 and 3.*

None of the reservoir sites are situated on soils with high corrosivity.

No Impact; Alternatives 1, 4, and 5.

These alternatives do not have a storage reservoir component.

Mitigation: No mitigation is proposed.

Pump Station Component

Table 4.3-10

Geology Impacts by Component - Pump Stations

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
3.6.1. Will the pump station component be located within an area of unstable slope conditions?	Overall rating of Moderate to High	Low	P	❍
3.6.2. Will the pump station component be subject to ground rupture due to location near a surface trace of an active fault?	Any portion of facilities within the Alquist-Priolo earthquake fault zones	No	P	==
3.6.3. Will the pump station component be located in areas with soils and groundwater conditions that are susceptible to liquefaction during an earthquake?	A rating of High for liquefaction			
• S, BUS, FGS, SEB		High	P	⊙
• All other pump stations		Moderate to Low	P	❍
3.6.4. Will the pump station component induce seismicity?	Effects of Modified Mercalli V or greater decreasing in recurrence interval by 50% or more for earthquakes with existing recurrences intervals of greater than one year	None	P	==
3.6.5. Will earthquake-induced strong ground shaking damage pump station components?	Construction not in conformance with requirements of the Division of Safety of Dams or applicable building code	None	P	==
3.6.6. Will construction of the pump station component cause off-site water-related soil erosion?	Construction activities not in compliance with requirements of the project NPDES permit, Division of Safety of Dams regulations or building and grading codes	None	C	==

Table 4.3-10

Geology Impacts by Component - Pump Stations

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
3.6.7. Will the pump station component be exposed to damage due to expansive soils?	A rating of Moderate to High for shrink-swell potential			
• ASW; T; SBPS 2, 3, 7-12; FGB; ARSW; L; AR; TCSW; SP; WBPS3; G3		Moderate to High	P	⊙
• All other pump stations		Low	P	○
3.6.8. Will the pump station component be exposed to damage due to construction on corrosive soils?	A rating of High for corrosion potential	Moderate to Low	P	○

Source: Parsons Engineering Science, Inc. 1996

Notes:

1. Type of Impact:
   - C Construction
   - P Permanent

2. Level of Significance:
   - = No impact
   - ○ Less than significant impact; no mitigation proposed
   - ⊙ Significant impact before mitigation; less than significant impact after mitigation

Impact: **3.6.1. Will the pump station component be located within areas of unstable slope conditions?**

Analysis: *Less than Significant; Alternatives 2, 3, and 4.*

Most primary pump stations and booster pump stations for irrigation pipelines are located on gently sloping terrain, typically on level areas along the side of roadways. Although some pump stations are close to hills and mountains, none of the locations are prone to instability.

Construction of large pump stations will be required under the Geysers Recharge Alternative; the two northernmost geysers pump stations are located on steep slopes adjacent to Pine Flat Road. Pump station PS-G3 is located on a relatively resistant ridge of Franciscan sandstone that is surrounded by landslide deposits. This mass of rock is apparently a coherent block within the melange. Pump Station PS-G4 is located on a broad ridge that is underlain by terrace deposits overlying Franciscan bedrock. The geologic material underlying these two pump stations should provide an adequate foundation for the proposed pump stations (Rust Environment and Infrastructure, Inc. 1995). Additional site specific geotechnical investigations should be conducted prior to final design and

issuance of a building permit. Preliminary reconnaissance indicates that the geysers pump stations are relatively stable locations within an otherwise unstable terrain.

No Impact; Alternatives 1 and 5.

These alternatives do not have a pump station component.

Mitigation: No mitigation is proposed.

Impact: 3.6.2, 4-6. Will the pump station component have geologic impacts based on evaluation criteria 2, 4, 5, and 6?

Analysis: *No Impact; All Alternatives.*

No pump stations are located in an Alquist-Priolo earthquake fault zone.

Pump stations will not increase the elevation of groundwater or increase water pressure beneath them, so there will be no inducement of seismicity.

Design and construction of pump stations will be in conformance with applicable building codes, National Pollutant Discharge Elimination System Permit, and grading ordinances.

Mitigation: No mitigation is needed.

Impact: 3.6.3. Will the pump station component be located in areas with soils and groundwater conditions that are susceptible to liquefaction during an earthquake?

Analysis: *Significant; Alternatives 2, 3, and 4.*

South County and West County (S, BVS, FGS, SEB) and geysers (G1) pump stations are located in areas that are mapped as having a high potential for liquefaction by California Division of Mines and Geology (1994) or were identified as having a high potential for liquefaction during geotechnical investigations for this project (Rust 1995).The remainder of the pump stations are located in areas rated Low to Moderate for liquefaction potential.

No Impact; Alternatives 1 and 5.

These alternatives do not have a pump station component.

Mitigation: *Alternatives 2, 3, and 4.*

2.3.5. Liquefaction Stabilization Design.

Alternatives 1 and 5. No mitigation is needed.

After Mitigation: *Less than Significant after Mitigation; Alternatives 2, 3, and 4.*

This measure avoids liquefaction hazards by removing liquefaction-prone soils, de-watering, or providing foundations at a depth where liquefaction is not expected to occur.

Impact: **3.6.7. Will the pump station component be exposed to damage due to expansive soils?**

Analysis: *Significant; Alternatives 2, 3, and 4.*

Tolay Extended (TASW; T; SBPSE, 8, 10; FGB), Adobe/Lakeville (ARSW; L; AR; SBPS 3, 8, 10, and 11; FGB), Tolay Confined (TCSW; T; SBPS 2, 3, 8, 10, 11; FGB), Lakeville/Sears Point (SP; L; SBPS 3, 7-12; FGB), West County (WBPS3, FGB), and geysers (G3) pump stations are located on soils with moderate to high potential for shrink-swell hazards. Pump stations underlain by highly expansive soils are located mainly in the South County area.

No Impact; Alternatives 1 and 5.

These alternatives do not have a pump station component.

Mitigation: *Alternatives 2, 3, and 4.*

2.4.3. Standard Engineering Methods for Expansive Soils.

Alternatives 1 and 5. No mitigation is needed.

After Mitigation: *Less than Significant after Mitigation; Alternatives 2, 3, and 4.*

This measure avoids impacts by removing the expansive soils, or remediates the situation be changing the composition of the soil, or avoids impacts by providing a deeper foundation or footing.

Impact: **3.6.8. Will the pump station component be exposed to damage due to corrosive soils?**

Analysis: *Less than Significant; Alternatives 2, 3, and 4.*

No pump stations are located on soils with a high potential for corrosion.

No Impact; Alternatives 1 and 5.

These alternatives do not have a pump station component.

Mitigation: No mitigation is proposed.

Table 4.3-11

Geology Impacts by Component - Agricultural Irrigation

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
3.7.1. Will the agricultural irrigation component be located within an area of unstable slope conditions?	Overall rating of Moderate to High	Low	P	❍
3.7.2. Will the agricultural irrigation component be subject to ground rupture due to location near a surface trace of an active fault?	Any portion of facilities within the Alquist-Priolo earthquake fault zones	None	P	==
3.7.3. Will the agricultural irrigation component be located in areas with soils and groundwater conditions that are susceptible to liquefaction during an earthquake?	A rating of High for liquefaction for project facilities except irrigaton pipes		P	--
3.7.4. Will the agricultural irrigation component induce seismicity?	Effects of Modified Mercalli V or greater decreasing in recurrence interval by 50% or more for earthquakes with existing recurrences intervals of greater than one year	None	P	==
3.7.5. Will earthquake-induced strong ground shaking damage agricultural irrigation components?	Construction not in conformance with requirements of the Division of Safety of Dams or applicable building code	None	P	==

Table 4.3-11

Geology Impacts by Component - Agricultural Irrigation

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
3.7.6. Will construction of the agricultural irrigation component cause off-site water-related soil erosion?	Construction activities not in compliance with requirements of the project NPDES permit, Division of Safety of Dams regulations or building and grading code	None	C O&M O&M-CP	==
3.7.7. Will the agricultural irrigation component be exposed to damage due to expansive soils?	A rating of Moderate to High for shrink-swell potential for project facilities except irrigation pipes	--	P	--
3.7.8. Will the agricultural irrigation component be exposed to damage due to construction on corrosive soils?	A rating of High for corrosion potential			
• Bay flats and Lakeville irrigation areas		High	P	⊙
• All other irrigation areas		Moderate to Low	P	❍

Source: Parsons Engineering Science, Inc.,1996

Notes:

1. Type of Impact:
   - C Construction
   - P Permanent
   - O&M-CP Contingency Plan

2. Level of Significance:
   - == No impact
   - ❍ Less than significant impact; no mitigation proposed
   - ⊙ Significant impact before mitigation; less than significant impact after mitigation
   - -- Not applicable

Impact: **3.7.1. Will the agricultural irrigation component be located in an area of unstable slope conditions?**

Analysis: *Less than Significant; Alternatives 2 and 3.*

Use of reclaimed water for agricultural irrigation could result in slope instability if unstable slopes were irrigated or if excessive amounts of water were applied to the land. Implementation of Project measures 2.2.3, Restrict Surface and Subsurface Irrigation Water Runoff, and 2.2.4, Restrict Soil Erosion and Sediment Movement (Irrigation Sites), will prevent over irrigating and will regulate soil saturation levels. In addition, development of new agricultural areas for irrigation in areas with slopes steeper than ten percent would be carefully reviewed under provisions of the Irrigation Management Guidelines for West County and South County Alternatives (Questa Engineering Coporation 1996). If soils and/or geologic conditions are determined to be unsuitable for irrigated cultivation, reclaimed water will not be provided.

No Impact; Alternatives 1, 4, and 5.

These alternatives do not have an agricultural irrigation component.

Mitigation: No additional mitigation is proposed.

Impact: **3.7.2. Will the agricultural irrigation component be subject to ground rupture due to location near a surface trace of an active fault?**

Analysis: *No Impact; All Alternatives.*

Fault rupture will not affect agricultural irrigation areas because no known active faults traverse these areas.

Alternatives 1, 4, and 5 do not have an agricultural irrigation component.

Mitigation: No mitigation is needed.

Impact: **3.7.3. Will the agricultural irrigation component be located in areas with soils and groundwater conditions that are susceptible to liquefaction during an earthquake?**

Analysis: *Not Applicable; Alternatives 2 and 3.*

Irrigation pipelines and pumps in areas underlain by alluvial soils with shallow groundwater will be vulnerable to damage caused by liquefaction. Irrigation facilities in Sebastopol, the bay flats, and in the Americano Creek area would be at risk of liquefaction during a large earthquake. However, damage to pipelines and pump stations from liquefaction will be localized and reclaimed water released from the damaged pipelines will be confined to the immediate area of the damage, due to the fact that irrigation pipelines have shut-off valves. Thus these facilities are excluded from this criterion.

Winter irrigation under the Contingency Plan will only occur during dryer-than-normal winters, and impacts will not be different from standard agricultural irrigation.

No Impact; Alternatives 1, 4, and 5.

These alternatives do not have an agricultural irrigation component.

Mitigation: No mitigation is proposed.

Impact: 3.7.4. Will the agricultural irrigation component induce seismicity?

Analysis: *No Impact; All Alternatives.*

Agricultural irrigation will not involve injection of reclaimed water into groundwater or build-up of pressure that could induce seismicity.

Alternatives 1,4,and 5 do not have an agricultural component.

Mitigation: No mitigation is needed.

Impact: 3.7.5 Will earthquake-induced strong ground shaking damage irrigation systems?

Analysis: *No Impact; All Alternatives.*

Building codes are not applicable to design and construction of irrigation facilities, but would conform to standard engineering practices. It is possible that minor damage to irrigation equipment could occur during an earthquake. Repairs will be of the type associated with regular maintenance activities (e.g., replacement of broken couplings) and could be readily implemented. This impact is thus not assessed to be significant.

These alternatives do not have an agricultural irrigation component.

Mitigation: No mitigation is needed.

Impact: 3.7.6. Will the agricultural irrigation component cause off-site water-related soil erosion?

Analysis: *No Impact; All Alternatives.*

Construction of irrigation facilities will conform with requirements of the National Pollutant Discharge Elimination System Permit, and will be governed by a Stormwater Pollution Prevention Plan, which will contain an erosion and sediment control plan. The requirement for a Stormwater Pollution Prevention Plan is outlined in Section 2.2.10.

Winter irrigation under the Contingency Plan will only occur during dryer-than-normal winters, and impacts will not be different from standard agricultural irrigation.

Alternatives 1,4 and 5 do not have an agricultural irrigation component

Mitigation: No mitigation is proposed.

Impact: 3.7.7. Will agricultural irrigation facilities be exposed to damage due to expansive soils?

Analysis: *Not Applicable; Alternatives 2 and 3.*

Lakeville/Bay Flats, North Petaluma, East of Rohnert Park agricultural irrigation are located on soils with moderate to high shrink-swell potential. Underground irrigation facilities (pipelines) could be damaged, however any release of reclaimed water from pipeline damage will be confined to the immediate area of the damage, due to the fact that irrigation pipelines have shut-off valves. Thus, these facilities are excluded from this criterion.

All West County agricultural irrigation areas are rated low for shrink-swell potential.

No Impact; Alternatives 1, 4, and 5.

These alternatives do not have an agricultural irrigation component.

Mitigation: No mitigation is proposed.

Impact: 3.7.8. The agricultural irrigation component may be exposed to damage due to corrosive soils.

Analysis: *Significant; Alternative 2.*

The Bay Flats and Lakeville agricultural irrigation areas have a high corrosion potential and present a significant hazard to irrigation pipes. The East of Rohnert Park, Adobe Road and North of Petaluma agricultural areas have a low to moderate corrosion potential.

Less than Significant; Alternative 3.

Corrosion potential is low to moderate and the hazard to facilities is less than significant.

No Impact; Alternative 1, 4, and 5.

These alternatives do not have an agricultural irrigation component.

Mitigation: *Alternative 2.*

2.3.6. Standard engineering methods for corrosive soils.

Alternatives 1, 3, 4, and 5. No mitigation is proposed.

After Mitigation: *Less than Significant after Mitigation; Alternative 2.*

This measure avoids the corrosive soil problem by changing the type of pipe which will be used in the Project or restricting the placement of the pipe to above ground.

Geysers Steamfield Component

Table 4.3-12

Geology Impacts by Component - Geysers Steamfield

Evaluation Criteria	As Measured by	Impact	Potential Type of Impact[1]	Level of Significance[2]
3.8.1. Will the geysers steamfield component be located within an area of unstable slope conditions?	Overall rating of Moderate to High	Moderate to Low	P	⊙
3.8.2. Will the geysers steamfield component be subject to ground rupture due to location near a surface trace of an active fault?	Any portion of facilities within the Alquist-Priolo earthquake fault zones	None	P	==
3.8.3. Will the geysers steamfield component be located in areas with soils and groundwater conditions that are susceptible to liquefaction during an earthquake?	Any facility within area rated High for liquefaction	None	P	==
3.8.4. Will the geysers steamfield component induce seismicity?	Effects of Modified Mercalli V or greater decreasing in recurrence interval (RI) by 50% or more for earthquakes with existing recurrences intervals of greater than one year	RI decrease of 38%	O&M	○
3.8.5. Will earthquake-induced strong ground shaking damage geysers steamfield components?	Structural design and construction not in conformance with requirements of the Division of Safety of Dams or applicable building codes	None	P	==
3.8.6. Will construction of the geysers steamfield component cause off-site water-related soil	Construction activities not in compliance with requirements of the	None	C	==

Table 4.3-12

Geology Impacts by Component - Geysers Steamfield

Evaluation Criteria	As Measured by	Impact	Potential Type of Impact[1]	Level of Significance[2]
erosion?	project National Pollutant Discharge Elimination System Permit (NPDES), Division of Safety of Dams regulations, or building and grading codes			
3.8.7. Will the geysers steamfield component be exposed to damage due to expansive soils?	A rating of Moderate to High for shrink-swell potential	Low	P	❍
3.8.8. Will the geysers steamfield component be exposed to damage due to construction on corrosive soils?	A rating of High for corrosion potential	Moderate to Low	P	❍

Source: Harland Bartholomew & Associates, Inc., 1996

Notes: 1. Type of Impact:
- C Construction
- O&M Operation and Maintenance
- P Permanent

2. Level of Significance:
- = No impact
- ❍ Less than significant impact; no mitigation proposed
- ⊙ Significant impact before mitigation; less than significant impact after mitigation

Impact: 3.8.1. Will the geysers steamfield component be located in an area of unstable slope conditions?

Analysis: *Significant; Alternative 4.*

New pipelines within the geysers steamfield would traverse areas of steep terrain similar to the geysers pipeline alignment along Pine Flat Road. Slope instability could result in pipeline damage and/or rupture within the geysers steamfield area. Construction of new pipes within the geysers steamfield area will be subject to the existing use permit for the area, which specifies grading permits are required for new construction.

The distribution tanks at the end of the pipeline will be located on a ridge top. This area is underlain by Franciscan Complex melange and it is

likely that the ridge is underlain by a resistant block of sandstone or greenstone within the melange (Rust Environment and Infrastructure, Inc. 1995). Landslides have been mapped on lower slopes northwest of the tank site. However, the ridge appears to be stable and should provide an adequate foundation for the proposed storage tank stations (Rust Environment and Infrastructure, Inc. 1995).

No Impact; Alternative 1, 2, 3, and 5.

These alternatives do not have a geysers steamfield component.

Mitigation: *Alternative 4.*

2.3.4 Slope Stabilization Design

Alternatives 1, 2, 3, and 5. No mitigation is needed.

After Mitigation: *Less than Significant after Mitigation; Alternative 4.*

This measure reduces impacts by implementing standard geotechnical recommendations.

Impact: 3.8.2, 3, 5, 6. Will the geysers steamfield component have geologic impacts based on evaluation criteria 2, 3, 5 and 6.

Analysis: *No Impact; All Alternatives.*

Geothermal steamfield facilities will not be located within an Alquist-Priolo earthquake fault zone.

None of the geysers steamfield facilities are located in an area rated as High for liquefaction potential by the California Division of Mines and Geology. Therefore, no significant liquefaction hazard will result from this project component.

The construction of the geysers steamfield facilities will be in conformance with applicable building codes the National Pollutant Discharge Elimination System Permit and grading ordinances.

Alternatives 1, 2, 3, and 5 do not have a geysers steamfield component.

Mitigation: No mitigation is needed.

Impact: 3.8.4. Will the geysers steamfield component induce seismicity?

Analysis: Less than Significant; Alternative 4.

Injection of reclaimed water into deep geothermal wells and extraction of steam and hot water could result in increased seismic activity within a 10-kilometer (6.2-mile) radius of the geysers (Figure 4.3-15). Based on statistical analysis (Greensfelder and Associates and Parsons ES 1996) it is estimated that the Project will not affect the maximum magnitude of

earthquakes that occur in the region. However, Project activities could increase the frequency of occurrence of earthquakes producing ground shaking intensity of Modified Mercalli V and VI (Table 4.3-1). Although ground shaking intensity less than Modified Mercalli VI does not produce structural damage, some non-structural damage could occur (Figure 4.3-15).

Analysis of induced seismicity indicates that the Project will result in approximately 14 microearthquakes per year per injection well. Up to 10 injection wells are proposed, therefore, the Project could result in up to 140 additional microearthquakes per year. Microearthquakes include magnitude 0.7 to 3.0. Many of these earthquakes will not be felt by people. A few microearthquakes could produce ground shaking intensity V on Modified Mercalli scale and can result in broken dishes, cracked windows, and cracked and fallen plaster in structures located in the vicinity of the geysers including Loch Lomond, Pine Grove, Hobergs, Cobb, Whispering Pines, and Anderson Springs.

The historical felt earthquake reports from Cobb indicate that during the period of 1980 to 1985, which was the peak geothermal energy production period, the recurrence interval[10] for earthquakes producing ground shaking intensity V was about two years. The statistical model indicates that the 1995 recurrence interval for intensity V earthquakes is 1.6 years and that the Project will decrease the recurrence interval to 1.0 year, an estimated 38 percent increase in frequency (Greensfelder and Parsons 1996). Therefore, the Project could cause the occurrence of earthquakes of Modified Mercalli intensity V, which may cause broken dishes and cracked plaster to increase from about sounds actual six events per decade to about ten events per decade.

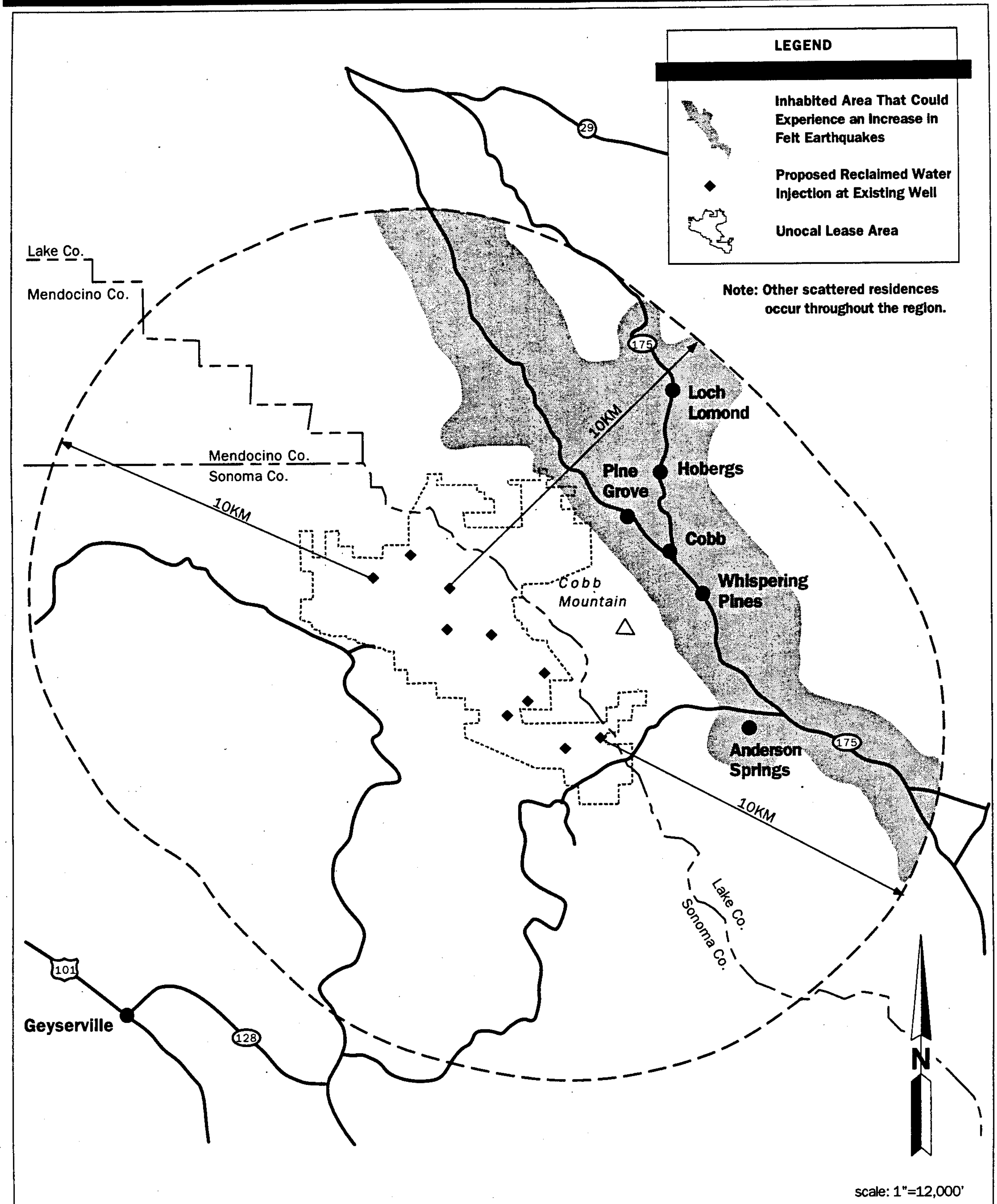
Effects of induced seismicity were modeled based on a peak injection rate of 19.5 mgd at the end of Project, when flows at the Laguna Plant have reached their capacity. Actual injection rates and resulting seismicity will start out considerably lower, and the average rate of injection at the end of the project would be 17.4 mgd. This analysis thus predicts the highest level of seismicity that might be expected. Based on the significance criteria, impacts from induced seismicity will be less than significant.

No Impact; Alternatives 1, 2, 3, and 5.

These alternatives do not have a geysers steamfield component.

Mitigation: *Alternative 4.*

[10] Recurrence interval is the average amount of time between events of equal intensity. A recurrence interval of ten years indicates that the event will occur, on average, once every ten years.



Source: Parsons Engineering Science

HARLAND BARTHOLOMEW & ASSOCIATES, INC.
PARSONS ENGINEERING SCIENCE, INC.
UNITS OF PARSONS INFRASTRUCTURE & TECHNOLOGY INC.
PARSONS

Santa Rosa
Subregional Long-Term Wastewater Project

INHABITED AREAS POTENTIALLY AFFECTED by INCREASED FREQUENCY of FELT EARTHQUAKES

Figure 4.3-15

GEYSERS INDUCED SEISMICITY STUDY

2.3.8 Earthquake Preparedness and Emergency Response Plan.

2.5.8 Monitor seismic events and adjust injection rates.

Alternatives 1, 2, 3, and 5. No mitigation is needed.

Impact: **3.8.7. Will the geysers steamfield component be exposed to damage due to expansive soils?**

Analysis: *Less than Significant; Alternative 4.*

The proposed tanks and pipelines within the geysers geothermal steamfield are underlain by gravelly loam soils that have a low shrink-swell potential.

No Impact; Alternatives 1, 2, 3, and 5.

These alternatives do not have a geysers steamfield component.

Mitigation: No mitigation is proposed.

Impact: **3.8.8. Will the geothermal steamfield component be exposed to damage due to corrosive soils?**

Analysis: *Less than Significant; Alternative 4.*

Native soils within the geysers geothermal steamfield have low to moderate corrosivity ratings. However, industrial processes at the geysers may increase the risk of corrosion of steel pipes and other structures. This increased corrosion is typical of geothermal areas and is a result of chemical compounds in the recovered water and steam. Use of reclaimed water is expected to reduce the presence of deleterious compounds in the recovered steam and water and should, overall, reduce corrosion potential at geothermal facilities.

No Impact; Alternatives 1, 2, 3, and 5.

These alternatives do not have a geysers steamfield component.

Mitigation: No mitigation is proposed.

Discharge Component

Table 4.3-13

Geology Impacts by Component - Discharge

Evaluation Criteria	As Measured by	Impact	Type of Impact[1]	Level of Significance[2]
3.9.1. Will the discharge component be located within an area of unstable slope conditions? • Russian River • Laguna	Overall rating of Moderate to High	 Low None	 P P	 ○ ==
3.9.2. Will the discharge component be subject to ground rupture due to location near a surface trace of an active fault?	Any portion of facilities within the Alquist-Priolo earthquake fault zones	None	P	
3.9.3. Will the discharge component be located in areas with soils and groundwater conditions that are susceptible to liquefaction during an earthquake? • Russian River • Laguna	A rating of High for liquefaction	 High None	 P P	 ⊙ ==
3.9.4. Will the discharge component induce seismicity?	Effects of Modified Mercalli V or greater decreasing in recurrence interval by 50% or more for earthquakes with existing recurrences intervals of greater than one year	None	O&M, O&M-CP	==
3.9.5. Will earthquake-induced strong ground shaking damage discharge components?	Structural design and construction not in conformance with requirements of the Division of Safety of Dam or applicable building codes	None	P	==
3.9.6. Will construction of the discharge components cause off-site water-related erosion?	Construction activities not in compliance with requirements of the project National Pollutant Discharge Elimination System Permit (NPDES),	None	C	==

Table 4.3-13

Geology Impacts by Component - Discharge

Evaluation Criteria	As Measured by	Impact	Type of Impact[1]	Level of Significance[2]
	Division of Safety of Dams regulations, or building and grading codes.			
3.9.7. Will the discharge component be exposed to damage due to expansive soils?	A rating of Moderate to High for shrink-swell potential.			
• Russian River		Low	P	❍
• Laguna		None	P	=
3.9.8. Will the discharge component be exposed to damage due to construction on corrosive soils?	A rating High for corrosion potential			
• Russian River		Moderate or Low	P	❍
• Laguna		None	P	=

Source: Harland Bartholomew & Associates, Inc., 1996

Notes:

1. Type of Impact:
- C — Construction
- P — Permanent
- O&M — Operations and Maintenance
- O&M-CP — Contingency Plan

2. Level of Significance:
- = No impact
- ❍ Less than significant impact; no mitigation proposed
- ⊙ Significant impact before mitigation; less than significant impact after mitigation

Impact: **3.9.1. Will the discharge component be located in an area of unstable slope conditions?**

Analysis: *Less than Significant; Alternative 5A*

The Russian River discharge outfall will be constructed in an area of gently sloping terrain. The river bank may have locally steep slopes but the area is not considered to be unstable.

No Impact; Alternatives 1, 2, 3, 4, and 5B.

These alternatives do not have a new discharge outfall.

Mitigation: No mitigation is proposed.

Impact: **3.9.2. Will the discharge component be subject to ground rupture due to location near a surface trace of an active fault?**

Analysis: *No Impact; All Alternatives.*

The discharge outfall for Alternative 5A is not located within an Alquist-Priolo earthquake fault zone

Alternatives 1, 2, 3, 4, and 5B do not have a new discharge outfall.

Mitigation: No mitigation is needed.

Impact: 3.9.3. Will the discharge component be located in areas with soils and groundwater conditions that are susceptible to liquefaction during an earthquake?

Analysis: *Significant; Alternative 5A.*

The discharge facility along the Russian River will be located in an area with a high liquefaction potential. Liquefaction in this area could cause lateral spreading at the exposed river bank which could damage the outlet structure. The outfall structure will be exposed to significant impacts because the area has a high liquefaction potential.

No Impact; Alternative 1, 2, 3, 4, and 5B.

These alternatives do not have a new discharge outfall.

Mitigation: *Alternative 5A.*

2.3.5. Liquefaction Stabilization Design.

Alternatives 1, 2, 3, and 5B. No mitigation is needed.

After Mitigation: *Less than Significant after Mitigation; Alternative 5A.*

This measure avoids liquefaction hazards be removing liquefaction-prone soils, de-watering, or providing foundations at a depth where liquefaction is not expected to occur.

Impact: 3.9.4-6. Will the discharge component have geologic impacts based on evaluation criteria 4, 5, and 6?

Analysis: *No Impact; All Alternatives.*

The Russian River discharge outfall does not involve direct injection of water that could induce seismicity.

The construction of discharge facilities will be in conformance with applicable building codes.

Construction of a river outfall structure could result in streambank erosion during the construction period. However, construction will be in conformance with NPDES permit and grading ordinances, which will prevent significant impacts. In addition, the following measure, included as part of the Project, specifies that construction of a Russian River outfall

would be restricted to the low flow period, when the water level is below the construction area: 2.2.5 Avoid Sensitive Biological Resources.

Combined with erosion control procedures specified in Chapter 2, this will avoid any significant impacts during construction of the outfall.

Potential erosion impacts related to increased river flows are discussed in Section 4.4, Surface Water Hydrology.

Mitigation: No additional mitigation is needed.

Impact: 3.9.7. Will the discharge component be exposed to damage due to expansive soils?

Analysis: *Less than Significant; Alternative 5A.*

Soils at the discharge outfall are composed of silt, sand, and gravel and have a low to moderate shrink-swell potential.

No Impact; Alternatives 1, 2, 3, 4, and 5B.

These alternatives do not have a new discharge outfall.

Mitigation: No mitigation is proposed.

Impact: 3.9.8. Will the discharge component be exposed to damage due to corrosive soils?

Analysis: *Less than Significant; Alternative 5A*

Soils at the discharge outfall have a low corrosivity rating.

No Impact; Alternatives 1, 2, 3, 4, and 5B

These alternatives do not have a new discharge outfall.

Mitigation: No mitigation is proposed.

CUMULATIVE IMPACTS

There are seven impacts – either less than significant or significant – identified in the Geology, Soils, and Seismicity section:

- Unstable slope conditions; potential for ground rupture, ground shaking, or liquefaction from an earthquake; damage from expansive or corrosive soils.
- The Project will construct additional facilities in a seismically active area, and thus contributes to the cumulative exposure of structures to seismic hazards in the region as a whole. However, this is the case for any project constructed in the state of California, and the actual level of risk is site specific and would not be cumulatively increased at any particular site.
- Induced seismicity. Geysers steamfield

Other sources of induced seismicity are the geysers geothermal resource activity and injection of water from Lake County Sanitary District. Cumulative impacts from these sources have been considered in the analysis presented in the Geology analysis section. The Lake County project has minor cumulative impacts on induced seismicity. The table below shows that there is virtually no difference between recurrence intervals with the Santa Rosa project (R+G+S) and predicted intervals with both the Santa Rosa and Lake County Projects (R+G+L+S).

Table 4.3-14

Recurrence Interval of Earthquake Effects at Cobb

Modified Mercalli Scale	Project	Project/Lake County Project
III	6.1 days	6.0 days
IV	33 days	33 days
V	.94 years	.93 years
VI	8.4 years	8.3 years
VII	80 years	80 years
VIII	900 years	900 years

Source: Taken from Table 7.3 in *Induced Seismicity Study Geysers Recharge Alternative*, Greensfelder 1996.

Summary of Significant Impacts and Mitigation Measures

Table 4.3-15

Summary of Significant Impacts and Mitigation Measures – Geology, Soils, and Seismicity

	Level of Significance	Mitigation Measures
Pipeline Component		
3.4.1. The pipeline component may be located within an area of unstable slope conditions.	Alt 2 - ⊙ Alt 3 - ⊙ Alt 4 - ●	2.3.4. Slope Stabilization Design 2.3.7. Slope Monitoring and Response System 2.3.8. Earthquake Preparedness and emergency Response Plan
3.4.2. The pipeline component may be subject to ground rupture due to location near surface trace of an active fault.	Alt 2 - ● Alt 3 - ● Alt 4 - ●	2.3.8. Earthquake Preparedness and Emergency Response Plan
3.4.3. The pipeline component may be located in areas with soils and groundwater conditions that are susceptible to liquefaction during an earthquake.	Alt 2 - ⊙ Alt 3 - ⊙ Alt 4 - ⊙ Alt 5A - ⊙	2.3.5. Liquefaction Stabilization Design
3.4.7. The pipeline component may be exposed to damage due to expansive soils.	Alt 2 - ⊙ Alt 3 - ⊙ Alt 4 - ⊙	2.4.8. Standard engineering methods for expansive soils
3.4.8. The pipeline component may be exposed to damage due to corrosive soils.	Alt 2 - ⊙	2.3.6. Standard engineering methods for corrosive soils.
Storage Reservoir Component		
3.5.1. The storage reservoirs component may be located within an area of unstable slope conditions.	Alt 2 - ●	2.3.4. Slope Stabilization Design 2.4.2. Remove weak surficial deposits from reservoir footprint

Table 4.3-15

Summary of Significant Impacts and Mitigation Measures – Geology, Soils, and Seismicity

	Level of Significance	Mitigation Measures
3.5.7. The reservoirs component may be exposed to damage due to expansive soils.	Alt 2 - ⊙	2.4.2. Remove weak surficial deposits from reservoir footprints 2.4.3. Standard engineering methods for expansive soils
Pump Station Component		
3.6.3. The pump station component may be located in areas with soils and groundwater conditions that are susceptible to liquefaction during an earthquake.	Alt 2 - ⊙ Alt 3 - ⊙ Alt 4 - ⊙	2.3.5. Liquefaction Stabilization Design
3.6.7. The pump station component may be exposed to damage due to expansive soils.	Alt 2 - ⊙ Alt 3 - ⊙ Alt 4 - ⊙	2.4.3. Standard engineering methods for expansive soils
Agricultural Irrigation Component		
3.7.8. The agricultural irrigation component may be exposed to damage due to corrosive soils.	Alt 2 - ⊙	2.3.6. Use standard engineering methods for corrosive soils
Geysers Steamfield Component		
3.8.1 The geysers steamfield component may be located in an area of unstable slope conditions	Alt 4 - ⊙	2.3.4 Slope Stabilization Design
Discharge Component		
3.9.3. The discharge component may be located in areas with soils and groundwater conditions that are susceptible to liquefaction during an earthquake.	Alt 5A - ⊙	2.3.5. Liquefaction Stabilization Design

Source: Parsons Engineering Science, Inc., 1996

⊙ Significant impact before mitigation; less than significant impact after mitigation

● Significant impact before and after mitigation

SUMMARY OF IMPACTS BY ALTERNATIVE

Table 4.3-16

Summary of Impacts by Alternative - Geology, Soils, and Seismicity

Component	Alt 1	Alt 2A	Alt 2B	Alt 2C	Alt 2D	Alt 3A	Alt 3B	Alt 3C	Alt 3D	Alt 3E	Alt 4	Alt 5A	Alt 5B
No Action (No Project) Alternative	==	--	--	--	--	--	--	--	--	--	--	--	--
Headworks Expansion	--	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Urban Irrigation	--	==	==	==	==	==	==	==	==	==	--	--	--
Pipelines	--	●	●	●	●	●	●	●	●	●	●	●	--
Storage Reservoirs	--	●	●	●	●	❍	❍	❍	❍	❍	--	--	--
Pump Stations	--	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	--	--
Agricultural Irrigation	--	⊙	⊙	⊙	⊙	❍	❍	❍	❍	❍	--	--	--
Geysers Steamfield	--	--	--	--	--	--	--	--	--	--	⊙	--	--
Discharge	--	==	==	==	==	==	==	==	==	==	==	⊙	==

Source:: Parsons Engineering Science, Inc.,1996

Notes: Level of Significance Codes

- -- Not applicable
- ❍ Less than significant impact; no mitigation proposed
- ● Significant impact before and after mitigation
- == No impact
- ⊙ Significant impact; less than significant after mitigation

PREPARERS, REFERENCES, AND CONSULTATION AND COORDINATION

Preparers

Sandia Potter, R.G., R.E.A. Parsons Engineering Science, Inc.
Stan Kline, P.E., G.E. Rust Environment & Infrastructure
Fred Kintzer, R.G., C.E.G., Parsons Engineering Science, Inc.

Reviewers

Patricia I. Collins, Harland Bartholomew & Associates, Inc.
Robin P. Cort, Ph.D., Parsons Engineering Science, Inc.
Anders Hauge, Harland Bartholomew & Associates, Inc.
John Cummings, Ph.D., Peer Review Committee
David Ziegler, Peer Review Committee

References

HBA Team Documents

Greensfelder and Associates and Parsons Engineering Science Inc. 1996. *Induced Seismicity Study-Geysers Recharge Alternative.* September. (Appendix F-2).

Rust Environment and Infrastructure. 1995. *Geotechnical Assessment of Alternative Reservoir Sites and Pipeline Routes.* November. (Appendix F-1).

Other References

Allen, C.R. 1982. Reservoir-Induced Earthquakes and Engineering Policy. California Geology. November 35:11:248-250,

Association of Bay Area Governments. 1995. *The San Francisco Bay Area, On Shaky Ground.* April.

California Division of Mines and Geology. 1994. *Planning Scenario for a Major Earthquake on the Rodgers Creek Fault in the Northern San Francisco Bay Area.* Special Publication 112, July.

California Division of Mines and Geology. 1990. *Fault-Rupture Hazard Zones in California.* Special Publication 42.

California Division of Mines and Geology. 1982. *Planning Scenario for a Magnitude 8.3 Earthquake on the San Andreas Fault in the San Francisco Bay Area.* Special Publication 61.

California Division of Mines and Geology. 1974. *Potential Seismic Hazards in Santa Clara County California*. Special Report 107.

Eberhart-Phillips, D. and Oppenheimer, D.H. 1984. *Induced Seismicity in The Geysers Geothermal Area, California*. Journal of Geophysical Research, Vol. 89, no. B2, pp. 1191-1207. February.

Environmental Science Associates, Inc. 1994. *Southeast Regional Wastewater Treatment Plant Facilities Improvements Project and Geysers Effluent Pipeline Project (LACOSAN Project)*. Draft EIR/EIS prepared for Lake County Sanitation District and U.S. Bureau of Land Management. May.

Greensfelder, R.W. 1993. *New Evidence of the Causative Relationship Between Well Injection and Microseismicity in the Geysers Geothermal Field*. Geothermal Resources Council Transactions, vol. 17, pp. 243-247.

Harding-Lawson Associates. 1974. *Soil Investigation Laguna Wastewater Treatment Plant Additions*. Llano Road, Santa Rosa, California. June.

Lake County Sanitation District. 1994. *Southeast Regional Wastewater Treatment Plant Facilities Improvement Project Geysers Effluent Pipeline Project* Draft EIR/EIS. May.

Lawson. 1908. *The California Earthquake of April 18, 1908*. Report of the State Earthquake Investigation Commission.

Stark, M.A. 1991. *Microearthquakes - A Tool to Track Injected Water in the Geysers Reservoir*. Geothermal Resources Council Monograph on The Geysers Geothermal Field, Special Report No. 17, pp. 111-117.

Toppozada, T.R., Real, C.R., and Parke, D.L. 1981. *Preparation of Isoseismal Maps and Summaries of Reported Effects for Pre-1900 California Earthquakes*. California Division of Mines and Geology Open File Report 81-11 SAC.

United States Department of Agriculture, Forest Service and Soil Conservation Service. 1972. *Soil Survey of Sonoma County, California*. May.

United States Department of Agriculture, Soil Conservation Service. 1994. *National Soil Survey Handbook*. April.

Wagner D.L. and Bortugno E.J. 1983. *Geology of the Santa Rosa Quadrangle, California Geology*, v. 36 no 12, pp.257-280.

Wagner D.L. and Bortugno E.J., (Compilers). 1982. *Geologic Map of the Santa Rosa Quadrangle, California, 1:250,000*, California Division of Mines and Geology, Regional Geologic Map Series, Map 2A, Sheet 1 of 5.

Wesnousky, S.G. 1986. *Earthquakes, Quaternary Faults, and Seismic Hazards in California*, Journal of Geophysical Research, v.91, n.B12. November.

Youd, T.L. and Hoose, S.N. 1978. *Historic Ground Failures in Northern California Associated with Earthquakes*. U.S.G.S. Professional Paper 993.

Hart, E.W. 1982.Fault Evaluation Report FER 140 (Tolay Fault). unpublished report prepared by the California Division of Mines and Geology.

Jennings, C.W. (compiler). 1994. Fault Activity Map of California and Adjacent Areas with Location and Ages of Volcanic Eruptions, Geologic Data Map No. 6.

U.S. Geological Survey, Working Group on California Earthquake Probabilities. 1990. Probabilities of Large Earthquakes in the San Francisco Bay region. California, U.S.G.S. Circular 1053.

Woodward-Clyde Consultants. 1990. Long-Term Detailed Reclamation Studies, Technical Memorandum No. R16 Storage Feasibility and Siting Phase 2, South County, West County and Sebastopol Sites. November 11.

Consultation and Coordination

Persons Contacted

Daniel Carlson, City of Santa Rosa Utilities Department

Joe Gaffney, City of Rohnert Park Engineering and Publics Works Department

Marie Meredith, City of Santa Rosa, Community Development Department

Carol Niberman, Sonoma County Permit Resources and Management Department

Division of Safety of Dams, John Wright

Correspondence

None.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

4.4 SURFACE WATER HYDROLOGY

This section discusses Project impacts resulting from streambank erosion or flooding in the Laguna de Santa Rosa or Russian River. The potential for flooding and streambank erosion as a result of irrigation and storage is evaluated, as is the potential for flooding due to rupture of Project pipelines. To provide a basis for this evaluation, the characteristics of major water bodies in the Project area, and existing hydrologic conditions are described. Data on estimated and measured monthly flows in the rivers and streams are provided.

IMPACTS EVALUATED IN OTHER SECTIONS

The following items are related to the Surface Water Hydrology Section but are evaluated in other sections of this document:

- Irrigation. The Surface Water Quality and the Aquatic Biological Resources sections, Sections 4.6 and 4.9 respectively, address how irrigation could affect water quality and aquatic habitat. .
- Dam Failure. The potential effects of dam failure are addressed in Section 4.19, Inundation from Dam Failure.
- Seepage of Reclaimed Water from Reservoirs. The potential impacts seepage could have on water quality and aquatic habitat are addressed in Sections 4.6 and 4.9.

AFFECTED ENVIRONMENT (SETTING)

The Project alternatives could affect flow in several water bodies, including the Russian River, Laguna de Santa Rosa, Americano Creek, Stemple Creek, Tolay Creek, Petaluma River, San Pablo Bay, and the Pacific Ocean. The general locations of these water bodies are shown in Figure 4.4-1.

Russian River

The Russian River drains a basin of approximately 1,485 square miles in Sonoma and Mendocino counties. The drainage basin, lying between adjoining ridges of the Coast Range, is about 80 miles long and from 10 to 30 miles wide. The total length of the river, from its source about 16 miles north of Ukiah to its mouth at Jenner, where it empties into the Pacific Ocean, is about 110 miles. Principal tributaries of the Russian River are Dry Creek and the Laguna de Santa Rosa. Dry Creek drains an area of 217 square miles in the west central portion of the drainage basin and empties into the Russian River about two miles south of Healdsburg. Mark West Creek, which is a tributary to the Laguna de Santa Rosa, drains an area of about 255 square miles located in the southeastern portion of the drainage basin and joins the Russian River at Mirabel Park. Other tributaries

include the East Fork, Big Sulphur Creek, Maacama Creek, Mill Creek, and Austin Creek (Sonoma County Water Agency 1980).

Russian River flows have been altered from their natural condition by a number of water resource development projects. Since 1908, water has been diverted from the Eel River and released into the East Fork of the Russian River through the Potter Valley Tunnel and Powerhouse. Between 1986 and 1992, the amount of water imported from the Eel River has averaged 188 cfs (136,000 acre-feet per year). The flow rate varied from a low of 44 cfs to a high of 310 cfs (Sonoma County Water Agency 1996).

Coyote Dam is located on the East Fork of the Russian River, just north of Ukiah. Lake Mendocino, the reservoir formed by the dam, stores about 122,400 acre-feet of water, and is used for water supply, recreation, flood control, and augmentation of summer stream flows in the Russian River. The dam and reservoir were built by the U.S. Army Corps of Engineers in 1958 (State of California Department of Water Resources 1994).

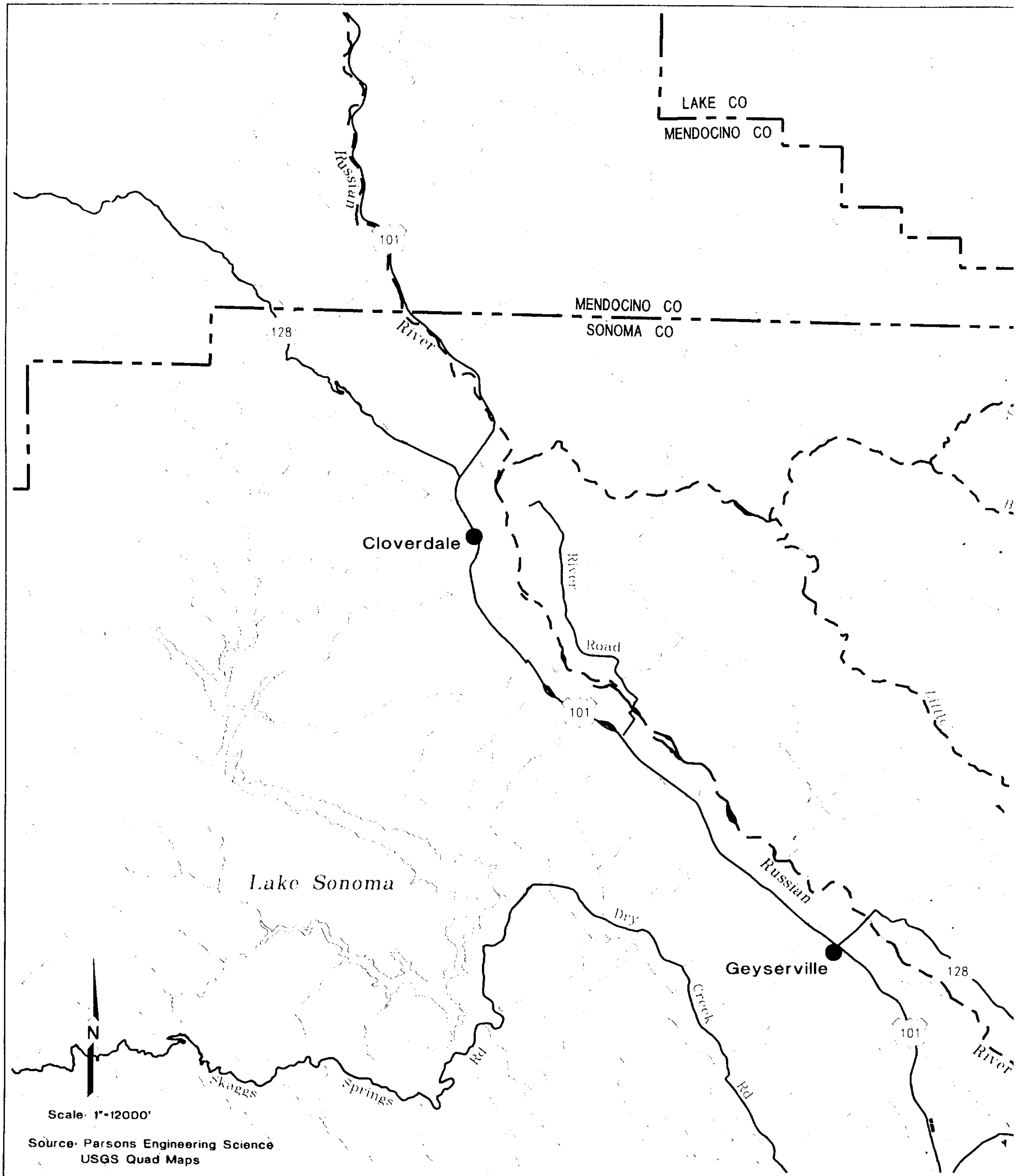
Warm Springs Dam was built by the U.S. Army Corps of Engineers in 1982 and is located on Dry Creek, approximately 15 miles upstream from its confluence with the Russian River. Lake Sonoma, the reservoir formed by the dam, has a capacity of 381,000 acre-feet and is used for water supply, flood control, augmentation of summer flow, and recreation (State of California Department of Water Resources 1994).

Several communities in the Russian River basin, including Ukiah, Cloverdale, Healdsburg, Windsor, Santa Rosa, and Guerneville, discharge wastewater to the River. Some of the discharges are direct and occur only seasonally, and others are continuous but indirect (via percolation ponds). Wastewater discharges to the River are described in Section 4.6, Surface Water Quality.

Streamflows in the Russian River basin vary widely from floods during the winter to small flows and even no flow in some tributaries during the dry summer months. Rainfall over the basin is considerable, averaging 41 inches per year. Eighty percent of the annual runoff occurs between December and March. Because winter storms often produce extended periods of intense rainfall over the drainage basin, flooding is frequent and severe. In 1986, a record river flow of 102,000 cubic feet per second (cfs) occurred at Guerneville, producing severe flooding. In 1995, the instantaneous peak flow at Guerneville was 93,900 cfs on January 10, 1995.

Tributary streams often dry up completely during the summer, although subsurface flow may still occur in the streambed gravel. A minimum summertime flow of 125 cubic feet per second is maintained during normal years in the Russian River at Guerneville by releases from Lake Mendocino and Lake Sonoma (Dames and Moore 1988a, Sonoma County Water Agency 1996). Summertime flow would be considerably less without these releases. Historic average monthly streamflows measured at Guerneville are shown in Table 4.4-1 and flows at Healdsburg are shown in Table 4.4-2.

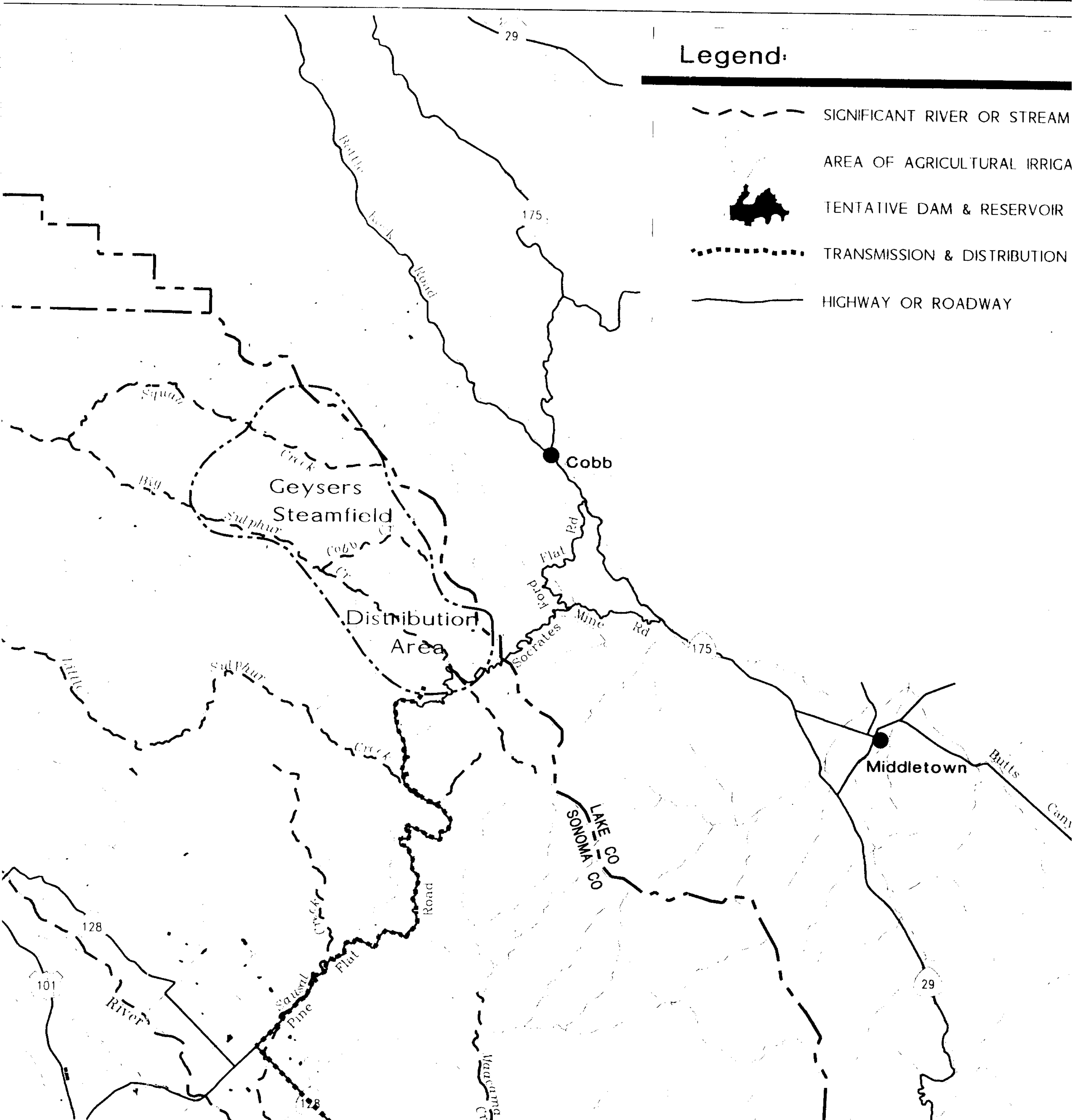
(1



HARLAND BARTHOLOMEW and ASSOCIATES, INC.
A UNIT OF PARSONS INFRASTRUCTURE and TECHNOLOGY GROUP INC.
PARSONS

Santa Ro

(2)



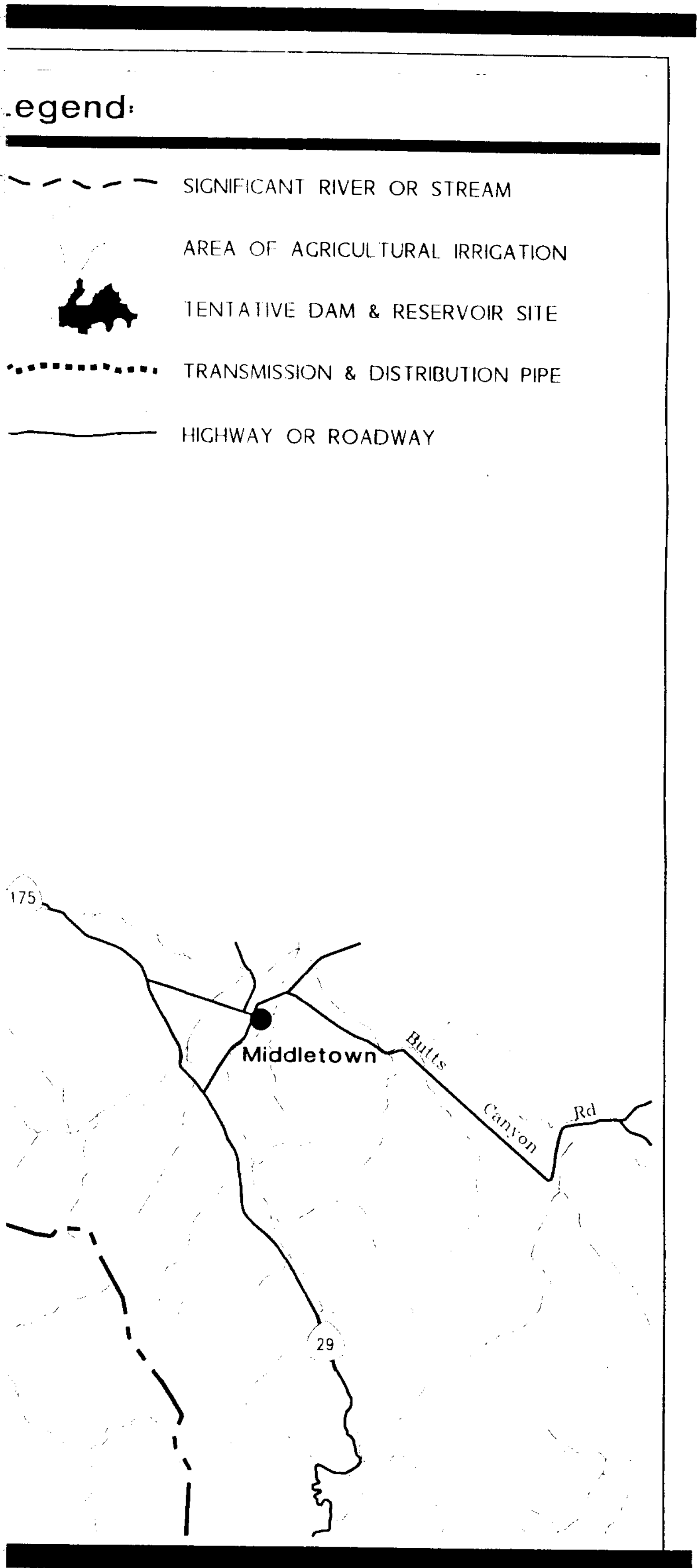
nta Rosa

Subregional Long-Term
Wastewater Project

WATERWAYS IN THE SANTA ROSA LONG-TERM PROJECT

Fig

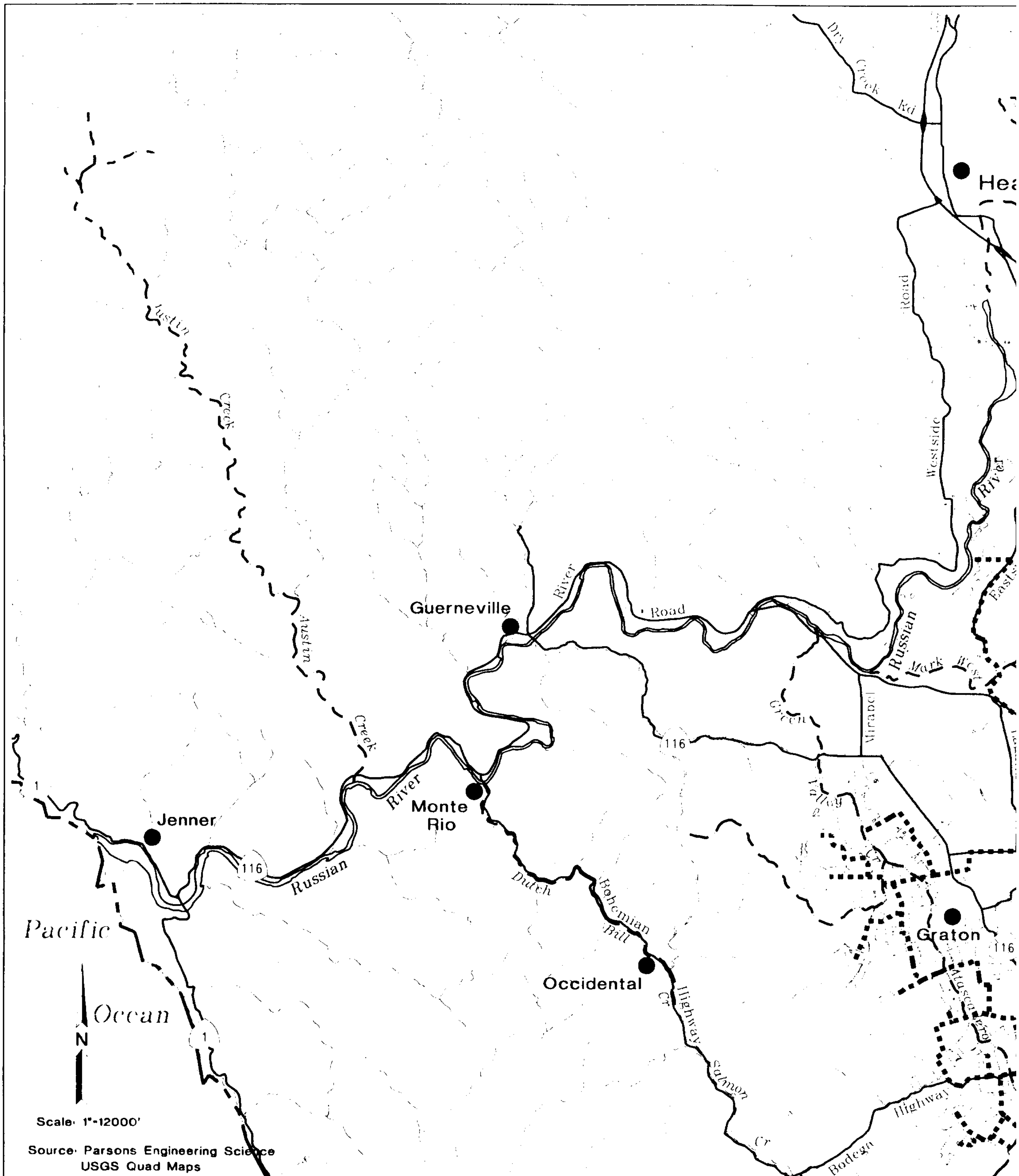
3



WATERWAYS IN THE SANTA ROSA LONG-TERM PROJECT AREA

Figure 4.4-1a

(1)



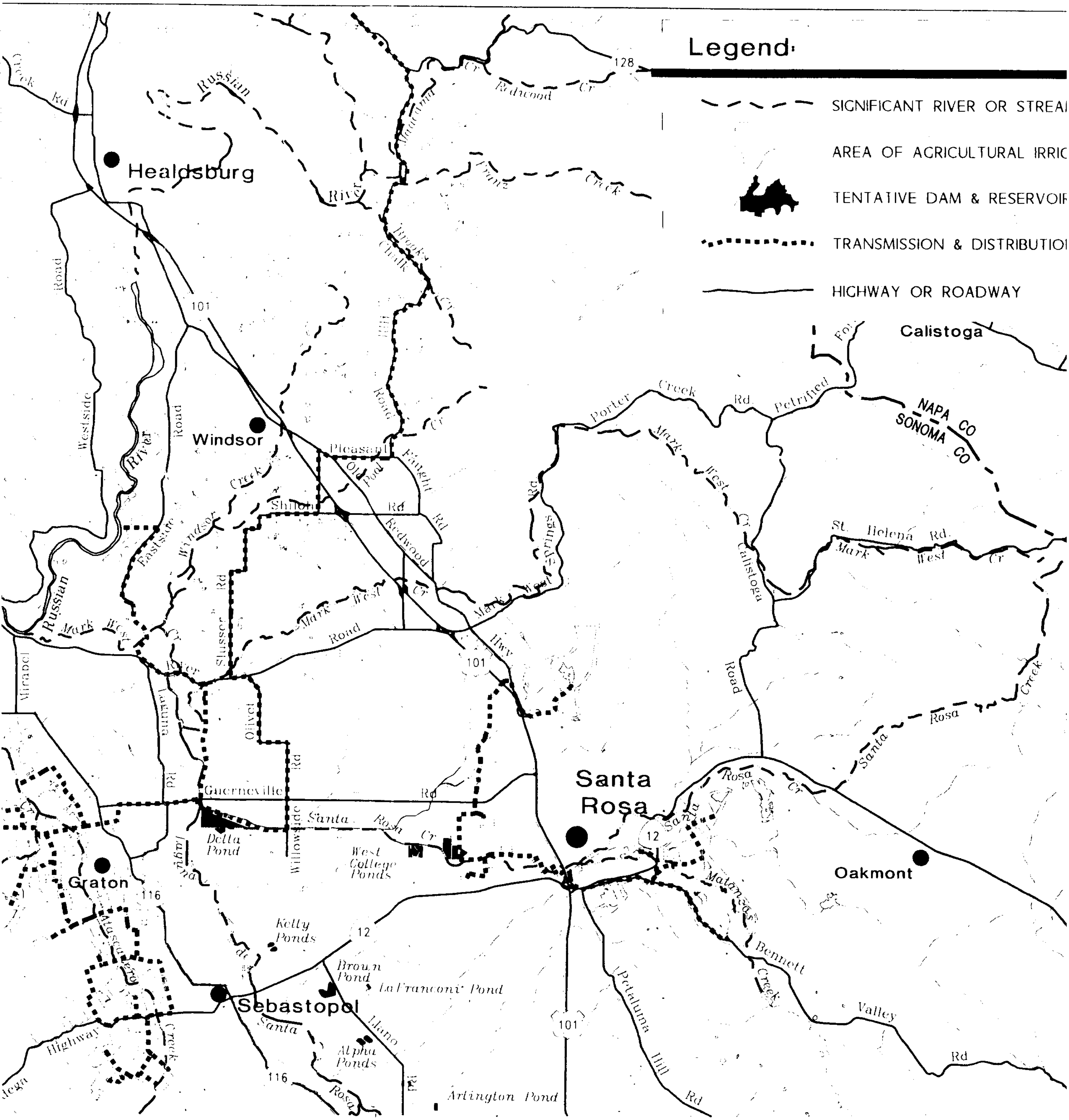
HARLAND BARTHOLOMEW and ASSOCIATES, INC.

A UNIT OF PARSONS INFRASTRUCTURE and TECHNOLOGY GROUP INC.

PARSONS

Santa Ros

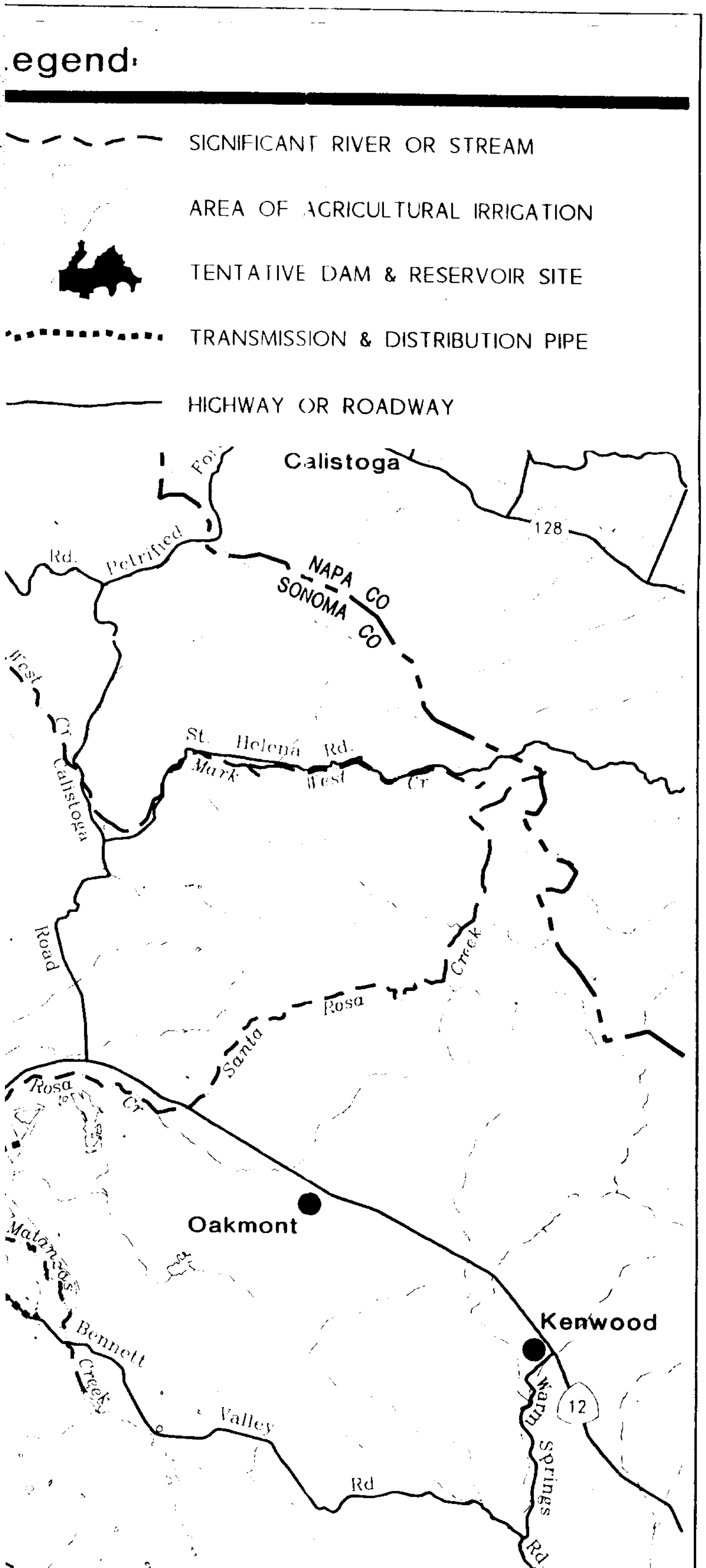
(2)



Santa Rosa
Subregional Long-Term
Wastewater Project

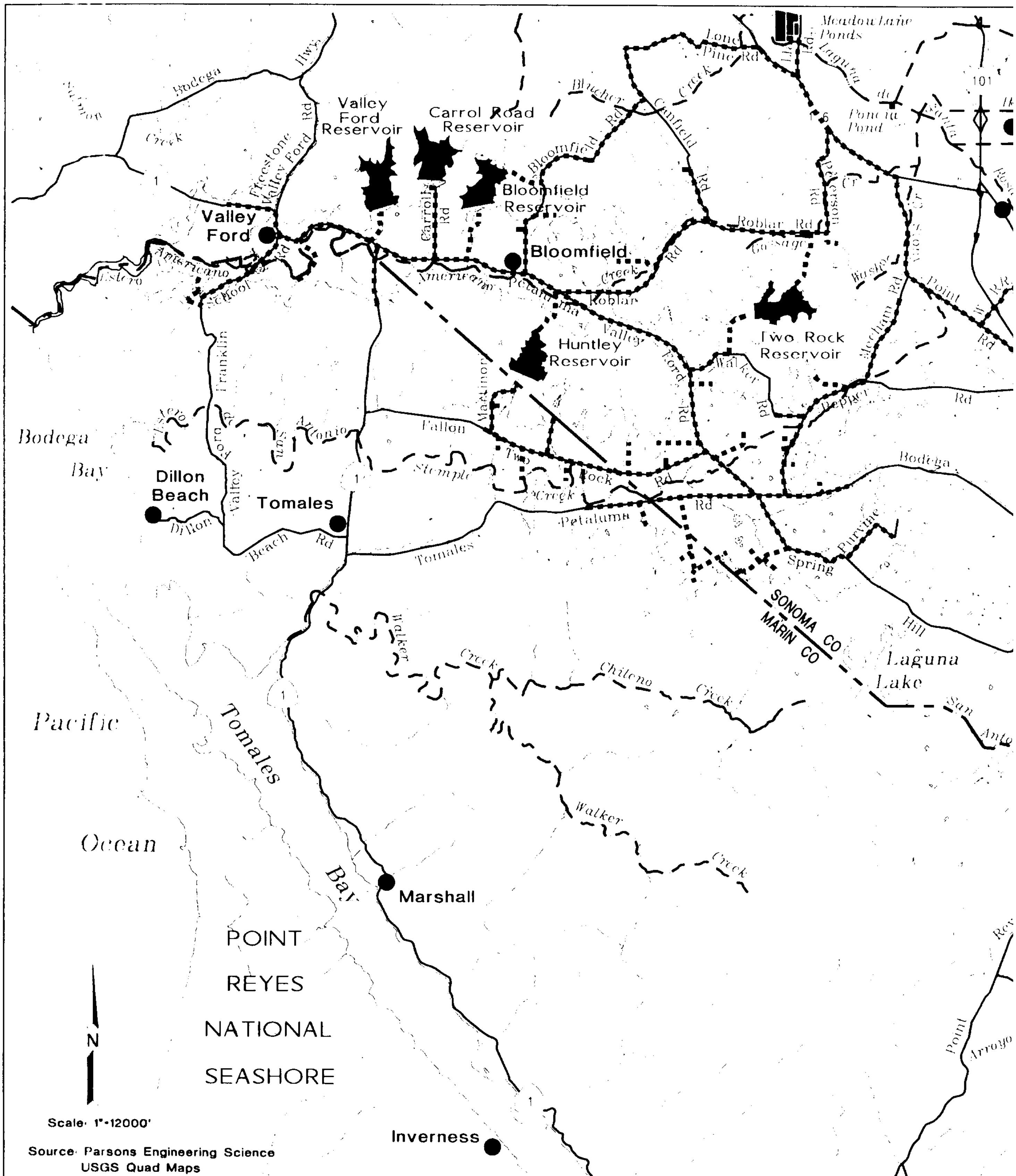
WATERWAYS F
IN THE SANTA ROSA
LONG-TERM PROJEC

(3)



WATERWAYS IN THE SANTA ROSA LONG-TERM PROJECT AREA Figure 4.4-1b

(1)



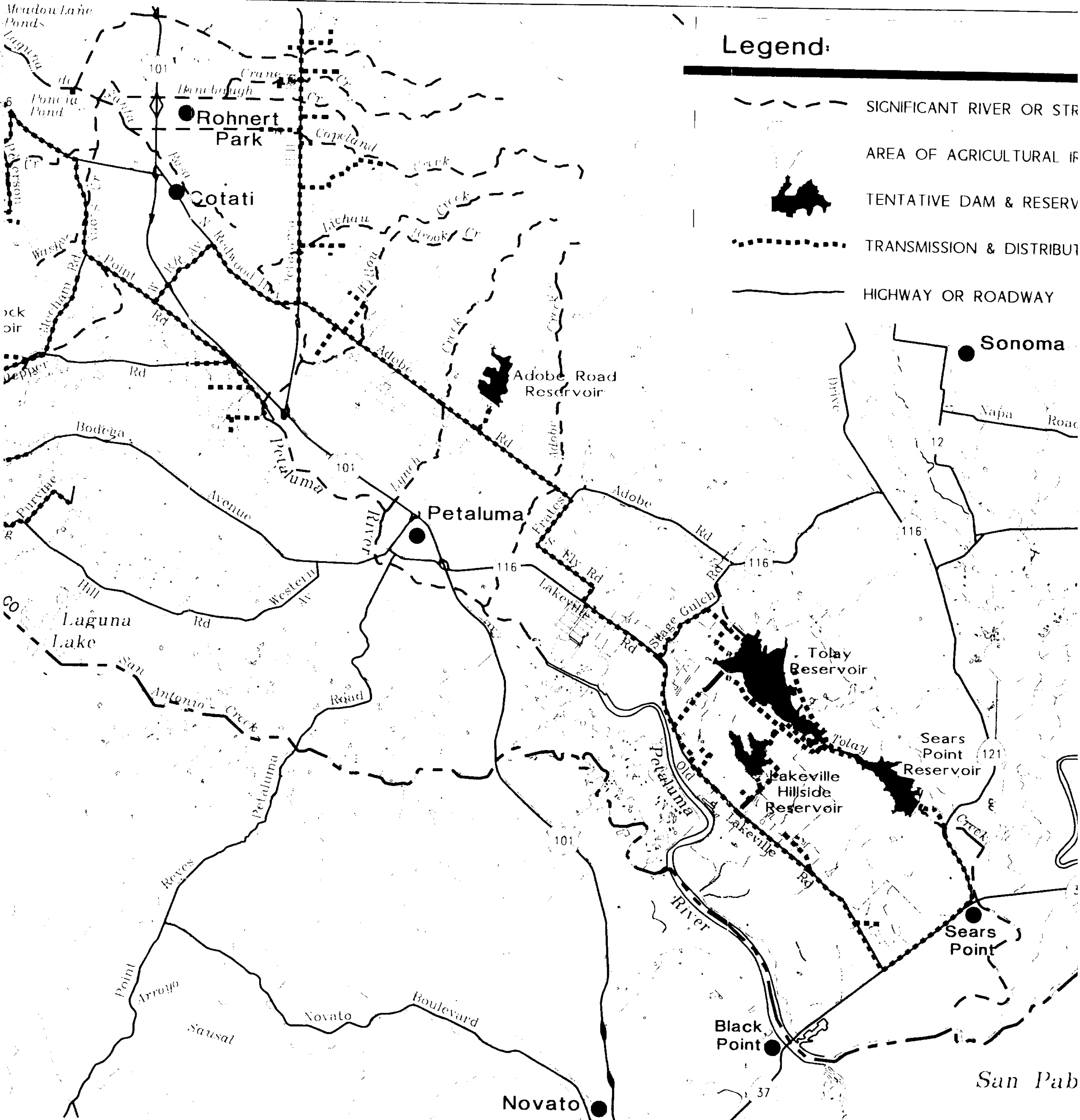
HARLAND BARTHOLOMEW and ASSOCIATES, INC.

A UNIT OF PARSONS INFRASTRUCTURE and TECHNOLOGY GROUP INC

PARSONS

Santa R

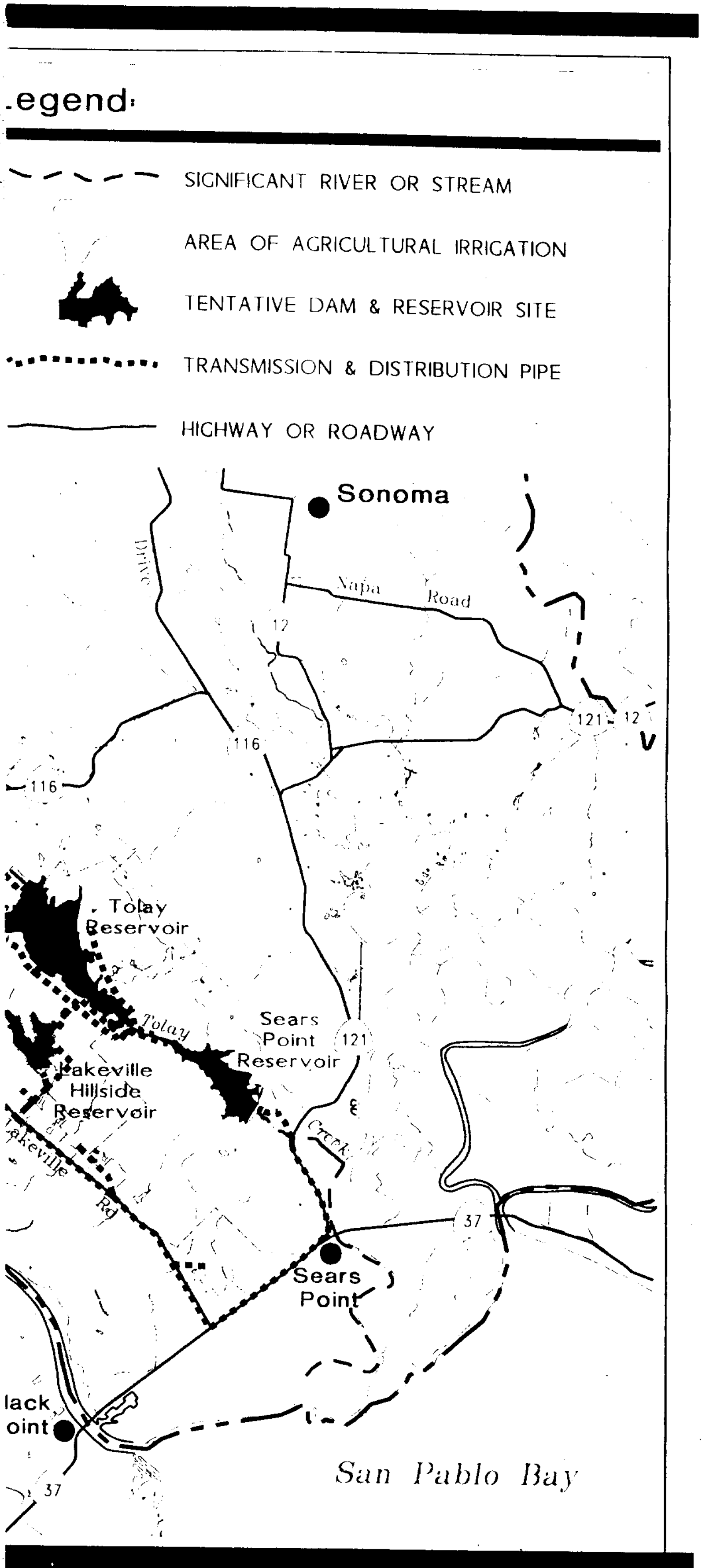
②



Santa Rosa
Subregional Long-Term
Wastewater Project

WATERWAYS
IN THE SANTA ROS
LONG-TERM PROJE

3



WATERWAYS IN THE SANTA ROSA LONG-TERM PROJECT AREA — **Figure 4.4-1c**

The Sonoma County Water Agency has prepared a streamflow model of the Russian River and used it to adjust the historically measured flows to account for water diverted from the river for municipal, agricultural, and other uses (Sonoma County Water Agency 1996). The model has been used to predict river flows for the present water diversion conditions and for future diversion conditions that may occur in the year 2010 if the water demand within the basin grows to projected levels.

The projected water demand for the year 2010 is based on estimates made by the California Department of Water Resources and Sonoma County Water Agency. Above Dry Creek the demand is based on Department of Water Resources estimates except that Sonoma County Water Agency estimates were used for the Russian River above Lake

Mendocino and for the Redwood Valley Water District. Demands below Dry Creek amount to 120,025 acre-feet per year corresponding to the future growth addressed in the general plans of communities within the Sonoma County Water Agency service area (Dames and Moore 1988a, Sonoma County Water Agency 1996).

Table 4.4-1

Average Monthly Flow in the Russian River near Guerneville, CA
USGS Gage No. 11467000

	USGS[1]					SCWA[2]	
Month	Average	Maximum		Minimum		Baseline Case	Projected 2010 Case
	(cfs)	(cfs)	Year	(cfs)	Year	(cfs)	(cfs)
Oct	321	2,515	1963	25	1978	277	223
Nov	1,249	9,425	1974	140	1940	1,179	1,085
Dec	4,147	17,413	1956	116	1977	3,529	3,457
Jan	6,413	25,208	1970	127	1977	5,174	5,016
Feb	6,557	26,022	1958	88	1977	6,172	6,046
Mar	4,502	23,293	1983	201	1977	4,073	3,986
Apr	2,340	11,701	1982	48	1977	2,485	2,397
May	695	2,798	1983	39	1977	839	729
June	283	681	1967	23	1977	348	247
July	174	348	1987	32	1977	196	148
Aug	166	308	1961	37	1977	183	137
Sept	182	345	1961	36	1977	170	138
Average Annual	2,236	5,898		89		2,052	1,967

Source: Merritt Smith Consulting 1996

Notes:
1. United States Geological Survey data for period of record 1939 - 1993, USGS Web Site and Dames and Moore (1988a)
2. Sonoma County Water Agency modeled the Russian River watershed to estimate monthly flows for present and future water diversion rates. "Baseline Case" represents river flow corresponding to present diversion rates and "Projected 2010" represents flows corresponding to estimated diversion rates in the year 2010. The values shown are the monthly adjusted flows for the period 1923-1992 based on water diversion projections dated March 28, 1995. (Sonoma County Water Agency 1996).

Table 4.4-2

Average Monthly Flow in the Russian River near Healdsburg, CA
USGS Gage No. 11464000

Month	USGS[1]					SCWA[2]	
	Average (cfs)	Maximum (cfs)	Maximum Year	Minimum (cfs)	Minimum Year	Baseline Case (cfs)	Projected 2010 Case (cfs)
Oct	281	1,605	1958	34	1978	249	218
Nov	818	5,293	1974	122	1992	830	772
Dec	2,482	8,945	1956	111	1991	2,312	2,275
Jan	3,875	13,667	1970	91	1977	3,250	3,225
Feb	3,860	14,647	1986	59	1977	3,679	3,680
Mar	2,736	11,811	1983	146	1977	2,389	2,394
Apr	1,480	6,592	1982	56	1977	1,545	1,528
May	537	1,638	1983	85	1977	587	567
June	260	669	1993	81	1977	271	251
July	186	300	1961	70	1947	187	183
Aug	186	331	1974	83	1947	178	176
Sept	192	360	1974	67	1977	155	153
Average Annual	1,390	3,277		101		1,303	1,285

Source: Merritt Smith Consulting 1996

Notes:
1. USGS data for period of record 1939 - 1993, USGS Web site and Dames and Moore (1988a)
2. Sonoma County Water Agency modeled the Russian River watershed to estimate monthly flows for present and future water diversion rates. "Baseline Case" represents river flow corresponding to present diversion rates and "Projected 2010" represents flows corresponding to estimated diversion rates in the year 2010. The values shown are the monthly adjusted flows for the period 1923-1992 based on water diversion projections dated March 28, 1995 (Sonoma County Water Agency 1996).

The analysis shows that flow in the River would average about 6 to 8 percent less than the historic flows if the present diversion conditions had been in effect throughout the period of record (1923 -1992). If the water diversions increase to the estimated levels for the year 2010, the average flow in the River is estimated to be about 8 to 12 percent less than the historic flow (see Tables 4.4-1 and 4.4-2).

The Russian River is the primary water supply for Sonoma County and parts of Marin County. It supplies an average of 70,000 acre-feet of water per year. The Sonoma County

Water Agency delivers 29,000 acre-feet per year to Santa Rosa, Rohnert Park, Cotati, and Forestville. An additional 25,000 acre-feet per year is exported to the cities of Novato, Petaluma, Sonoma, and to southern Marin County (State of California Department of Water Resources 1994).

Laguna de Santa Rosa

The Laguna de Santa Rosa is a significant hydrologic feature of the Lower Russian River basin, with a watershed of approximately 255 square miles. The Laguna is a wide, marshy area lying along the western edge of the Santa Rosa Plain that drains to the Russian River. The boundaries of the Laguna de Santa Rosa have lacked a clear definition in the past. The headwaters of the Laguna are located in the hills south and east of the City of Santa Rosa. The creek then enters the Santa Rosa Plain near Stony Point Road and meanders to the north. Immediately west and north of the City of Santa Rosa, the Laguna de Santa Rosa merges with Mark West Creek. Some have referred to the waterway as Mark West Creek from this point to the Russian River, and others have referred to the creek as the Laguna de Santa Rosa. For purposes of this report, the Laguna de Santa Rosa is defined as that area of the Santa Rosa Plain below elevation 75 feet, located between Stony Point Road to the south and the Russian River to the north.

During large storms the Laguna becomes a lake, temporarily storing water that would otherwise increase flood peaks farther down the Russian River. As the water level in the Russian River rises, water backs up into the Laguna, impeding downstream flow from the Laguna watershed itself. On average, a lake is formed every other year in the Laguna with a depth of 22 feet at the confluence with the Russian River. During the December 1964 - January 1965 storms, the Laguna became a lake with a surface area of 7,400 acres and a stored water volume of 80,000 acre-feet. The storage provided by the Laguna is estimated to have reduced downstream Russian River flow by approximately 40,000 cfs and the flood crest at Guerneville by 14 feet.

During the summer months, the Laguna becomes a slow-flowing stream confined within a narrow channel. Flow at this time is usually low. In dry years, the portion of the Laguna above the confluence with Santa Rosa Creek is reduced to isolated pools. Estimated and measured flows in the Laguna at Guerneville Road are shown in Table 4.4-3.

Currently, the Laguna Wastewater Treatment Plant releases reclaimed water directly into the Laguna de Santa Rosa during the winter months (1 October through 14 May), once the flow in the Russian River exceeds 1,000 cfs. These discharges are limited to one percent of the Russian River flow (with five percent allowed only by direct authorization by the North Coast Regional Board), but sometimes represent a much higher proportion of flow in the Laguna. During the summer months, a portion of the reclaimed water is used to irrigate pasture in the Laguna area.

Table 4.4-3

Estimated and Measured Flows in the Laguna de Santa Rosa System

Month	Estimated Average of Monthly Flow at Laguna de Santa Rosa at Guerneville Road[1] (cfs)	Measured Average Monthly Flow in Laguna de Santa Rosa at Trenton Healdsburg Rd[2] (cfs)	Measured Average Monthly Flow in Mark West Creek at Slusser Rd[2] (cfs)	Measured Average Monthly Flow in Santa Rosa Creek at Willowside Rd[2] (cfs)
Oct	20	78	4	30
Nov	117	62	15	57
Dec	352	307	46	157
Jan	645	917	211	559
Feb	657	821	84	212
Mar	368	357	15	169
Apr	173	125	5	77
May	32	69	2	81
June	11	23	0.5	49
July	4	6	1	16
Aug	4	5	1	18
Sept	5	4	1	15

Source: Merritt Smith Consulting 1996

Notes:
1. Dames & Moore 1988a
2. Calculated from data collected February 1991 through July 1992 and reported in Roth, et al (1991, 1992).

Americano Creek

Americano Creek is about 10 miles long and drains a 50-square-mile watershed. Watershed lands are either undeveloped or used by dairies. Americano Creek discharges to Estero Americano, a six-mile-long tidal channel extending to Bodega Bay. The Creek and Estero are shown in Figure 4.4-1.

Similar to many small coastal streams in central California, Americano Creek flows in the winter months and dries up, or is greatly reduced, in the summer. Flow was measured in Americano Creek between February 1991 and June 1992, which were very dry years. Estimated average monthly flows in Americano Creek are shown in Table 4.4-4. The

estimates do not take into account any diversions of water for agricultural use and thus may be somewhat higher than actual flows.

Table 4.4-4

Estimated and Measured Average Monthly Flow in West County Streams

Month	Measured Average Monthly Flow in Americano Creek[1] (cfs)	Estimated Average Monthly Flow in Americano Creek at Gericke Road[2] (cfs)	Estimated Average Monthly Flow in Stemple Creek at Highway 1[2] (cfs)
Oct	0	0.4	1
Nov	0.01	50	69
Dec	1.04	62	90
Jan	1.89	99	162
Feb	14.3	96	133
Mar	20.9	53	102
Apr	2.27	12	23
May	0.46	3	6
June	0.13	1	2
July	0	0	1
Aug	0	0	0
Sept	0	0	0

Source: Merritt Smith Consulting, 1996

Notes:
1. Baseline Hydrology and Irrigation Drainage Evaluation for West and South County Reclamation Alternatives, Questa 1996.
2. Calculated from February 1991 through July 1992 data reported in Roth et al (1991, 1992)

The tidal channel of Estero Americano is narrow (about three feet at its upper portion) but broadens to 1,000 feet near the ocean. The mouth of the Estero is open to the ocean during extended periods of high flow in the winter months. In the spring, as flow declines, ocean waves form a sand barrier across the mouth of the Estero and the Estero becomes a brackish lagoon. This process is explained further in Section 4.6, Surface Water Quality. When the mouth of the Estero is open, tidal influences extend inland beyond the community of Valley Ford. At mean lower low water (MLLW) the Estero contains about 80 million gallons of water. At mean higher high water (MHHW) it contains about 240 million gallons (Smith and Smith 1990).

Stemple Creek

Stemple Creek and the Estero de San Antonio have a total length of 15.5 miles and drain an area of about 60 square miles. The watershed of Stemple Creek is somewhat larger than that of Americano Creek, but is otherwise quite similar. The Stemple Creek watershed and the Estero de San Antonio are shown in Figure 4.4-1.

The seasonal pattern of flow in Stemple Creek is similar to that in Americano Creek and other small coastal streams in California. Stemple Creek flows in the winter months and dries up or is greatly reduced in the summer. Estimated average monthly flows are shown in Table 4.4-4.

The mouth of the Estero de San Antonio is typically open to the ocean when the creek is flowing during the winter months, but is closed by a sandbar as the flow decreases in the spring. This results in the formation of a brackish lagoon upstream of the sandbar during the summer and fall months.

Tolay Creek

The Tolay Creek watershed is located just north of San Pablo Bay, and is oriented in a north-south direction. The size of the Tolay Creek watershed is approximately 6,980 acres. Tolay Creek consists of three distinct segments. The upper segment is channelized within the broad, flat valley where agriculture is the dominant land use. The middle segment of Tolay Creek is approximately 2.5 miles long and connects the Tolay Valley (elevation 150 feet above sea level) to the lower, tidal segment of Tolay Creek. Tolay Creek downstream of Highway 121 is tidal and meanders through fresh and brackish water wetlands prior to discharge to San Pablo Bay.

Petaluma River

The watershed area of the Petaluma River basin, upstream of the USGS gage at Denman Flat, is approximately 80 square miles. Tidal influence from San Pablo Bay extends upstream of the City of Petaluma toward Denman Flat. The average annual runoff from the Petaluma River at the USGS gage was 17 cfs for the period 1948 to 1963, with a range of 2 to 45 cfs. Typically, about 95 percent of the runoff occurs during the months of November through April, while little or no flow occurs during May through October. Table 4.4-6 shows the monthly variation in flow. During the six wet months, the average monthly flow is about 34 cfs.

The City of Petaluma presently discharges reclaimed water to the tidal portion of the Petaluma River during the months December through April only, at a rate of about 5 million gallons per day (MGD) or 7.7 cfs. This discharge amounts to about 20 percent of the average monthly runoff during the December through April period.

Table 4.4-5

Estimated Average Monthly Flow in Tolay Creek

Month	Tolay Creek(cfs)
Oct	0
Nov	14
Dec	23
Jan	37
Feb	25
Mar	12
Apr	5
May	1
June	0
July	0
Aug	0
Sept	0

Source: *Baseline Hydrology and Irrigation Drainage Evaluation for West and South County Reclamation Alternatives*, Questa Engineering Corporation 1996.

Table 4.4-6

Average Monthly Flow in the Petaluma River at Petaluma, CA USGS Gage No. 11459000

Month	Average	Maximum		Minimum	
	(cfs)	(cfs)	Year	(cfs)	Year
Oct	1	12	1963	0	1962
Nov	2	31	1951	0	1962
Dec	38	220	1956	0	1960
Jan	59	212	1956	0.5	1957
Feb	64	271	1958	3	1953
Mar	28	81	1958	2	1959
Apr	14	112	1958	0	1959

Table 4.4-6

Average Monthly Flow in the Petaluma River at Petaluma, CA
USGS Gage No. 11459000

Month	Average	Maximum		Minimum	
	(cfs)	(cfs)	Year	(cfs)	Year
May	0.5	1	1956	0	1961
June	0	0	1953	0	1962
July	0	0	1963	0	1963
Aug	0	0	1955	0	1963
Sept	0	0	1955	0	1963
Average Annual	17	45[1]		2[1]	

Source: USGS data for period of record 1939 - 1993

Notes:
1. Maximum and minimum values are calculated for the period 1939-1993, not from the particular monthly values shown above

San Pablo Bay

The Petaluma River discharges to San Pablo Bay, which is part of the San Francisco Bay Delta system. Water movements in San Pablo Bay result primarily from tidal currents as ocean waters enter and leave the Golden Gate. They remain fairly constant through the year, although they are influenced by freshwater flood flows and winds. Currents are strongest in the deepwater channel that runs through the center of the Bay. Water movement is also influenced by freshwater inflow to the San Francisco Bay Delta system. About 40 percent of the land area in California drains into the Bay.

Between 1853 and 1884, hydraulic mining of gold in the Sierra Nevada washed tens of millions of tons of sand and mud into San Francisco Bay, reducing the extent of open water and creating new mud banks. Later, much of the tidal marsh surrounding San Francisco Bay was filled for urban and agricultural use. In this century, as industry expanded and urban sewage systems were built, increasing quantities of wastewater were discharged to San Francisco Bay. Freshwater inflow to the San Francisco Bay Delta system diminished as large quantities of water were diverted and exported to the San Joaquin Valley and Southern California for urban and agricultural use.

Surface Water Hydrology Goals, Objectives, and Policies

Table 4.4-7 identifies goals, objectives, and policies which provide guidance for development in relation to surface hydrology. The table also indicates which criteria in the Surface Water Hydrology Section are responsive to each set of policies.

Table 4.4-7

General Plan Goals, Objectives, and Policies - Surface Water Hydrology

Adopted Plan Document	Document Section	Document Numeric Reference	Policy	Relevant Evaluation Criteria[1]
Sonoma County General Plan	Public Safety Element	Goal PS-2.1 Objective PS-2.2 Policy PS-2f Policy PS-2j	Prevent unnecessary exposure of people and property to risks of damage or injury from flooding and regulate new development to reduce risks to acceptable levels	3,4,5
Marin Countywide Plan	Environmental Hazards Element	Policy EH-8.6 Policy EH-8.7	Ensure that capacity is maintained in stream channels to handle flood runoff, control filling and development which may increase flood damage, and prevent construction of flood barriers which will divert flood waters or increase flood hazards	5
Santa Rosa General Plan	Safety Element	Goal S-4	Identify and mitigate potential flooding hazards, to protect all uses from floods of a 100 year recurrence	3
Petaluma General Plan	Community Health and Safety Element	Objective (d) Objective (e)	Protect the community from risk of flood damage and preclude new developments from impacting the potential for flooding in developed areas	5
Sebastopol General Plan	Safety Element	Goal 3	Reduce Flood Hazards	3

Source: Harland Bartholomew and Associates, Inc. 1995

Notes:
1. Evaluation criteria are described in Table 4.4-8

EVALUATION CRITERIA WITH POINT OF SIGNIFICANCE

Table 4.4-8

Evaluation Criteria with Point of Significance - Surface Water Hydrology

Evaluation Criteria	As Measured by	Point of Significance	Justification
1. Will the Project discharge reclaimed water to the Laguna de Santa Rosa causing streambank erosion in the Laguna de Santa Rosa?	Percentage increases in the average stream power of the Laguna de Santa Rosa when the average channel velocity exceeds 3 feet per second (fps) in the Laguna.	Greater than 2 percent increase	Based on the typical particle size distribution for the Laguna, erosion of the material in the stream channel should only occur when the average channel velocity is greater than 3 fps.[1]
2. Will the Project discharge reclaimed water to the Laguna de Santa Rosa or the Russian River causing streambank erosion in the Russian River?	Percentage increases in the average stream power when the average channel velocity exceeds 4 fps in the Russian River.	Greater than 2 percent increase	Based on the typical particle size distribution for the Russian River, erosion of the material in the stream channel should only occur when the average channel velocity is greater than 4 fps.[1]
3. Will the Project discharge reclaimed water to the Laguna de Santa Rosa causing flooding anywhere along the Laguna de Santa Rosa?	Increase in the 100-year flood elevation mapped in the Flood Insurance Study.	Greater than 0.1 foot increase	Federal Emergency Management Agency (FEMA) uses 1 foot as a guideline for significance. Sonoma County Water Agency generally does not consider increases of less than 0.1 feet significant during project review.[2]
4. Will the Project discharge reclaimed water causing an increase in the maximum flood elevation in the Russian River?	Increase in the water surface elevation in the Russian River at the USGS Guerneville gage when the river is above flood stage. The USGS defines flood stage as 32.00 feet at the Guerneville Gage (elevation 52.01 feet NGVD), which corresponds to 39,530 cfs.	Greater than 0.1 foot increase	Federal Emergency Management Agency uses 1 foot as a guideline for significance. Sonoma County Water Agency generally does not consider increases of less than 0.1 feet significant during project review.[2]
5. Will non-discharge Project components cause flooding?	Increase in the peak water surface elevation.	Greater than 0.1 foot increase	Federal Emergency Management Agency uses 1 foot as a guideline for significance. Sonoma County Water Agency generally does not consider increases of less than 0.1 feet significant during project review.[2]

Table 4.4-8

Evaluation Criteria with Point of Significance - Surface Water Hydrology

Evaluation Criteria	As Measured by	Point of Significance	Justification
6. Will non-discharge Project components cause streambank erosion?	Increases in the average power in the stream.	Greater than 2 percent increase	A 2 percent power increase is considered minimal and insignificant. Any resulting erosion increase will be small relative to natural erosion rate variations.[1]
7. Will the Project cause flooding due to rupture of pipelines?	Bankful capacity of local waterway.	If release of water exceeds bankful capacity of local waterway	If the capacity of the local water is insufficient to contain the flow from the rupture, then flooding would result and this would be considered significant.

Source: Merritt Smith Consulting 1996

Notes:
1. *Potential Streambank Erosion Laguna de Santa Rosa and Russian River*, Dames & Moore, December 1995.
2. *Potential Flood Impacts, Laguna de Santa Rosa Floodplain and Russian River Floodplain*, Dames & Moore, December 1995.

METHODOLOGY

The evaluation of streambank erosion is based on water velocity and power, as indicated in Surface Hydrology evaluation criteria 1, 2, and 6. Power is the product of the weight of water (pounds per gallon), velocity (feet per second), water depth (feet), and stream slope (feet/foot). The calculation of velocity and power is described in *Potential Streambank Erosion Laguna de Santa Rosa and Russian River* (Dames & Moore 1996b). Velocity, water depth, and stream slope estimates used in Dames & Moore (1996b) were developed using the hydraulic and water quality model described in the *Russian River Water Quality Model* (Resource Management Associates 1996).

Flood impact analysis was conducted as described in *Potential Flood Impacts, Laguna de Santa Rosa and Russian River Floodplain* (Dames and Moore 1996b). Impacts were evaluated by estimating the maximum amount of reclaimed discharge that could occur instantaneously and over several days. The effect of such discharges on water surface elevation at key locations in the Laguna and River system under flood conditions that are specified in the evaluation criteria was evaluated using a stage curve that is unique for each location (Dames and Moore 1996b). The impact of storage reservoirs and related hydraulic control facilities on flooding was analyzed as described in the *Reservoir Spillway Hydrology Analysis* (Dames and Moore 1995a) and the *Reservoir Inflow Analysis* (Dames and Moore 1996c).

ENVIRONMENTAL CONSEQUENCES (IMPACTS) AND RECOMMENDED MITIGATION

No Action Alternative

Table 4.4-9

Hydrology Impacts by Component – No Action Alternative

Evaluation Criteria	As Measured by	Impact	Type of Impact[1]	Level of Significance[2]
4.1.1. Will the No Action Alternative discharge reclaimed water to the Laguna de Santa Rosa causing streambank erosion in the Laguna de Santa Rosa?	Greater than 2 percent increase of the average stream power of the Laguna when the average channel velocity exceeds 3 fps in the Laguna	Less than 2 percent	O&M	○
4.1.2. Will the No Action Alternative discharge reclaimed water to the Laguna de Santa Rosa or the Russian River causing streambank erosion in the Russian River?	Greater than 2 percent increase of the average stream power when the average channel velocity exceeds 4 fps in the Russian River	Less than 2 percent	O&M	○
4.1.3. Will the No Action Alternative discharge reclaimed water to the Laguna de Santa Rosa causing flooding anywhere along the Laguna de Santa Rosa?	Greater than 0.1-foot increase of the 100-year flood elevation	None	O&M	==
4.1.4. Will the No Action Alternative discharge reclaimed water causing an increase in the maximum flood elevation in the Russian River?	Greater than 0.1-foot increase of the water surface elevation in the Russian River at the USGS Guerneville gage during flood stage	None	O&M	==
4.1.5. Will non-discharge components of the No Action Alternative cause flooding in streams?	Greater than 0.1-foot increase of the peak water surface elevation	--	O&M	--
4.1.6. Will non-discharge components of the No Action Alternative cause streambank erosion?	Greater than 2 percent increase of the average power in the stream	--	O&M	--
4.1.7. Will the No Action Alternative cause flooding due to rupture of pipelines?	If release of water exceeds the capacity of local waterway during normal flow conditions	--	O&M	--

Source: Merritt Smith Consulting, 1996

Notes 1. Type of Impact:
O&M Operation and Maintenance
-- Not Applicable

2. Level of Significance:
== No impact
○ Less than significant impact; no mitigation proposed

Impact: **4.1.1-2. Will the No Action Alternative impact streambank erosion based on evaluation criteria 1 and 2?**

Analysis: *Less than Significant; Alternative 1.*

Streambank erosion may increase slightly as a result of the increased flow that is caused by the No Action discharge relative to existing condition. Based on the evaluation in Dames and Moore (1996b), this impact is considered to be less than significant.

Mitigation: No mitigation is proposed.

Impact: **4.1.3-4. Will the No Action Alternative impact flooding based on evaluation criteria 3 and 4?**

Analysis: *No Impact; Alternative 1.*

There is no potential for flooding impacts of the No Action Alternative due to increased discharge. Though annual discharge volume will increase, discharge to the Laguna during flood conditions will be limited to much less than 1 percent of River flow due to the hydraulic restriction inherent in the existing pump and pipe system. Therefore, potential discharge volumes at any specific time will not change from existing conditions and there will be no impact on flooding.

Mitigation: No mitigation is needed.

Impact: **4.1.5-7. The No Action Alternative is not applicable to evaluation criteria 5 through 7.**

Headworks Expansion Component

Impact: **4.2.1-7. Will the headworks expansion component impact surface water hydrology based on evaluation criteria 1 through 7.**

Analysis: *No Impact; All Alternatives.*

The headworks expansion component will not affect surface hydrology because the new pumps are located inside an existing building.

Alternative 1 does not have a headworks expansion component.

Mitigation: No mitigation is needed.

Urban Irrigation Component

Impact: 4.3. 1-4, 7. The urban irrigation component is not applicable to evaluation criteria 1, 2, 3, 4 and 7.

Impact: 4.3.5 and 6. Will the urban irrigation component impact surface water hydrology based on evaluation criteria 5 and 6?

Analysis: *No Impact; All Alternatives.*

Urban irrigation will not affect surface hydrology because the urban irrigation lands are already being irrigated and no change in irrigation practice will result from the Project.

Alternatives 1, 4 and 5 do not have an urban irrigation component.

Mitigation: No mitigation is needed.

Pipeline Component

Table 4.4-10

Hydrology Impacts by Component – Pipelines

Evaluation Criteria	As Measured by	Impact	Type of Impact[1]	Level of Significance[2]
4.4.1. Will the pipeline component discharge reclaimed water to the Laguna de Santa Rosa causing streambank erosion in the Laguna de Santa Rosa?	Greater than 2 percent increase of the average stream power of the Laguna when the average channel velocity exceeds 3 fps in the Laguna	--	O&M	--
4.4.2. Will the pipeline component discharge reclaimed water to the Laguna de Santa Rosa or the Russian River causing streambank erosion in the Russian River?	Greater than 2 percent increase of the average stream power when the average channel velocity exceeds 4 fps in the Russian River	--	O&M	--
4.4.3. Will the pipeline component discharge reclaimed water to the Laguna de Santa Rosa causing flooding anywhere along the Laguna de Santa Rosa?	Greater than 0.1-foot increase of the 100-year flood elevation	--	O&M	--

Table 4.4-10

Hydrology Impacts by Component – Pipelines

Evaluation Criteria	As Measured by	Impact	Type of Impact[1]	Level of Significance[2]
4.4.4. Will the pipeline component discharge reclaimed water causing an increase in the maximum flood elevation in the Russian River?	Greater than 0.1-foot increase of the water surface elevation in the Russian River at the USGS Guerneville gage during flood stage	--	O&M	--
4.4.5. Will the pipeline component cause flooding?	Greater than 0.1-foot increase of the peak water surface elevation.	None	O&M	==
4.4.6. Will the pipeline component cause streambank erosion?	Greater than 2 percent increase of the average power in the stream	None	O&M	==
4.4.7. Will the pipeline component cause flooding due to rupture of pipelines?	If release of water exceeds the capacity of local waterway during normal flow conditions	Less than stream capacity	O&M	O

Source: Merritt Smith Consulting 1996

Notes: 1. Type of Impact:
O&M Operation and Maintenance
-- Not Applicable

2. Level of Significance:
== No impact
O Less than significant impact; no mitigation proposed

Impact: 4.4.1-4. The pipeline component is not applicable to evaluation criterion 1, 2, 3, and 4.

Impact: 4.4.5-6. Will the pipeline component impact surface water hydrology based on evaluation criteria 5 and 6?

Analysis: *No Impact; All Alternatives.*

Neither construction nor operation of the pipelines will contribute any water to an existing waterway, and therefore no flooding or streambank erosion impacts will result.

Alternatives 1 and 5B do not have a pipeline component.

Mitigation: No mitigation is needed.

Impact: 4.4.7. Will the pipeline component cause flooding due to rupture?

Analysis: *Less than Significant; Alternative 2, 3 4, and 5A.*

An earthquake on the Maacama fault could cause rupture of the geysers pipeline, sending reclaimed water into Sausal Creek. Analysis of the impacts of pipeline ruptures indicates that the average rate of reclaimed water flow from a completely severed geysers pipeline would be approximately 31 cfs for approximately 2 hours. The hydraulic capacity of Sausal Creek at the location of the potential rupture is approximately 1,200 cfs. Unless the earthquake-induced rupture is coincident with a very large storm event, the reclaimed water flow due to a rupture will be contained by Sausal Creek. Thus, this impact is considered to be less than significant.

An earthquake on the Healdsburg-Rodgers Creek fault could cause rupture of the pipelines serving the Bennett Valley and/or Fountaingrove urban irrigation areas. Analysis of the impacts of a pipeline rupture indicates that the average rate of reclaimed water flow from a completely severed urban irrigation pipeline near the intersection of Bennett Valley Road and Farmers Lane would be approximately 4 cfs for about 30 minutes. The flow from a rupture of the Fountaingrove pipeline will be less than 4 cfs because the pipe diameter is less than that of the Bennett Valley pipe. Four cfs flow is approximately equal to the capacity of 1 large or 2 small drop inlets that are designed to convey stormwater runoff from the street and gutter. Thus, this impact is considered to be less than significant.

No Impact; Alternatives 1 and 5B.

These Alternatives do not have a pipeline component.

Mitigation: No mitigation is proposed.

Storage Reservoir Component

Table 4.4-11

Hydrology Impacts by Component – Storage Reservoirs

Evaluation Criteria	As Measured by	Impact	Type of Impact[1]	Level of Significance[2]
4.5.1. Will the storage reservoir component discharge reclaimed water to the Laguna de Santa Rosa causing streambank erosion in the Laguna de Santa Rosa?	Greater than 2 percent increase of the average stream power of the Laguna when the average channel velocity exceeds 3 fps in the Laguna	--	O&M	--
4.5.2. Will the storage reservoir component discharge reclaimed water to the Laguna de Santa Rosa or the Russian River causing streambank erosion in the Russian River?	Greater than 2 percent increase of the average stream power when the average channel velocity exceeds 4 fps in the Russian River	--	O&M	--

Table 4.4-11

Hydrology Impacts by Component – Storage Reservoirs

Evaluation Criteria	As Measured by	Impact	Type of Impact[1]	Level of Significance[2]
4.5.3. Will the storage reservoir component discharge reclaimed water to the Laguna de Santa Rosa causing flooding anywhere along the Laguna de Santa Rosa?	Greater than 0.1-foot increase of the 100-year flood elevation	--	O&M	--
4.5.4. Will the storage reservoir component discharge reclaimed water causing an increase in the maximum flood elevation in the Russian River?	Greater than 0.1-foot increase of the water surface elevation in the Russian River at the USGS Guerneville gage during flood stage	--	O&M	--
4.5.5. Will storage reservoir component cause flooding?	Greater than 0.1-foot increase of the peak water surface elevation downstream of the reservoir	Reduced peak flood elevation	O&M	❍
4.5.6. Will storage reservoir component cause streambank erosion?	Greater than 2 percent increase of the average power in the stream	No measurable change	O&M	❍
4.5.7. Will storage reservoir component cause flooding due to rupture of pipelines?	If release of water exceeds the capacity of local waterway during normal flow conditions	--	O&M	--

Source: Merritt Smith Consulting 1996

Notes: 1. Type of Impact:
O&M Operation and Maintenance
-- Not Applicable

2. Level of Significance:
= No impact
❍ Less than significant impact; no mitigation proposed

Impact: 4.5.1-4, and 7. The storage reservoir component is not applicable to evaluation criteria 1, 2, 3, 4, and 7.

Impact: 4.5.5. Will the storage reservoir component cause flooding in streams?

Analysis: *Less than Significant; Alternatives 2 and 3.*

Storage reservoirs will capture and retain rainfall runoff until the reservoir fills and then spills via the spillway. Some of the reservoirs (Tolay, Sears Point, Adobe Road) have been designed with a facility to intercept some of the runoff and divert it around the reservoir. Even reservoirs with diversion structures will always retain some surface water runoff and will reduce the peak water elevation at all downstream locations. Thus, the impact of reservoirs on flooding will always be to reduce potential

downstream flows, even if the reservoir fills and spills. Reservoirs can be considered beneficial with respect to downstream flooding. Reservoirs will intercept runoff and reduce the peak water surface elevation at all downstream locations.

No Impact; Alternatives 1, 4 and 5.

These alternatives do not have a storage reservoir component.

Mitigation: No mitigation is proposed.

Impact: 4.5.6. Will the storage reservoir component cause streambank erosion?

Analysis: *Less than Significant; Alternatives 2 and 3.*

The discharge of water from the diversion structures or spillways to the creek channel downstream of the storage reservoirs will increase the velocity and power of the water, and thus the potential to cause erosion. However, the spillways and diversion structures are designed to include riprap and other energy dissipation facilities so that the velocity of water will be approximately that which will normally occur in the channel in the absence of the reservoir. Thus, the effect of discharge from diversion structures and spillways will be approximately the same as existing conditions, and therefore the impact is considered less than significant.

Another source of downstream flows is seepage of reclaimed water through the floor of the reservoir. Seepage from any of the storage reservoirs has been estimated to be a maximum of 0.08 cfs (Merritt Smith Consulting 1996c), and this is not hydrologically significant according to the surface hydrology evaluation criteria. Energy and power dissipation to the level that will otherwise be present in the channel was a design criterion. Therefore, this impact is considered to be less than significant.

No Impact; Alternatives 1, 4 and 5.

These alternatives do not have a storage reservoir component.

Mitigation: No mitigation is proposed.

Pump Station Component

Impact: 4.6.1-7. Will the pump station component impact surface water hydrology based on evaluation criteria 1 through 7?

Analysis: *No Impact; All Alternatives.*

Pump stations will not affect surface hydrology because pumps are not located near streams nor in areas prone to flooding.

Alternatives 1 and 5 do not have a pump station component.

Mitigation: No mitigation is needed.

Agricultural Irrigation Component

Table 4.4-12

Hydrology Impacts by Component – Agricultural Irrigation

Evaluation Criteria	As Measured by	Impact	Type of Impact[1]	Level of Significance[2]
4.7.1. Will the agricultural irrigation component discharge reclaimed water to the Laguna de Santa Rosa causing streambank erosion in the Laguna de Santa Rosa?	Greater than 2 percent increase of the average stream power of the Laguna when the average channel velocity exceeds 3 fps in the Laguna	--	O&M	--
4.7.2. Will the agricultural irrigation component discharge reclaimed water to the Laguna de Santa Rosa or the Russian River causing streambank erosion in the Russian River?	Greater than 2 percent increase of the average stream power when the average channel velocity exceeds 4 fps in the Russian River	--	O&M	--
4.7.3. Will the agricultural irrigation component discharge reclaimed water to the Laguna de Santa Rosa causing flooding anywhere along the Laguna de Santa Rosa?	Greater than 0.1-foot increase of the 100-year flood elevation	--	O&M	--
4.7.4. Will the agricultural irrigation component discharge reclaimed water causing an increase in the maximum flood elevation in the Russian River?	Greater than 0.1-foot increase of the water surface elevation in the Russian River at the USGS Guerneville gage during flood stage	--	O&M	--
4.7.5. Will the agricultural irrigation component cause flooding?	Greater than 0.1-foot increase of the peak water surface elevation.	Less than 0.1 feet increase	O&M O&M-CP	❍ ❍
4.7.6. Will the agricultural irrigation component cause streambank erosion?	Greater than 2 percent increase of the average power in the stream	Less than 2 percent increase	O&M O&M-CP	❍ ❍

Table 4.4-12

Hydrology Impacts by Component – Agricultural Irrigation

Evaluation Criteria	As Measured by	Impact	Type of Impact[1]	Level of Significance[2]
4.7.7. Will the agricultural irrigation component cause flooding due to rupture of pipelines?	If release of water exceeds the capacity of local waterway during normal flow conditions	--	O&M	--

Source: Merritt Smith Consulting 1996

Notes: 1. Type of Impact:
- O&M Operation and Maintenance
- O&M -CP Operation and Maintenance Contingency Plan
- -- Not Applicable

2. Level of Significance:
- == No impact
- O Less than significant impact; no mitigation proposed

Impact: 4.7.1, 2, 3, 4 and 7. The agricultural irrigation component is not applicable to evaluation criteria 1, 2, 3, 4 and 7.

Impact: 4.7.5 and 6. Will the agricultural irrigation component impact surface water hydrology based on evaluation criteria 5 and 6?

Analysis: *Less than Significant; Alternatives 2 and 3*

The greatest incremental effect of agricultural irrigation on surface flow has been determined to be up to 1 cfs (Merritt Smith Consulting 1996b), and this would occur during summer. The total estimated flow (background plus irrigation-related inflow) in any of the streams that could be affected by irrigation (Tolay, Americano and Stemple) is less than 2 cfs in summer when irrigation would potentially affect flow. Over this range of flow (0 to 2 cfs), streambank erosion and flooding are not considered problematic, since these stream channels experience flows in excess of 100 cfs during winter. Thus, incremental flow is not expected to significantly affect water surface elevation or power (erosion) according to the surface water hydrology evaluation criteria 5 and 6.

Contingency-related irrigation impacts vary from no increase in surface flow to as much as a 2.5 cfs increase (Merritt Smith Consulting 1996b). The maximum incremental flow impact will occur during a dry winter in Stemple Creek. Since the incremental flow will occur only during dry years when flooding is not considered problematic, the impact of contingency irrigation on incremental flow is not expected to significantly

affect water surface elevation or power (erosion) and is not considered significant using the evaluation criteria in Table 4.4-7. The irrigation-related flow increment (2.5 cfs or less), which would occur only in a dry year, is small compared to the difference in average winter flow between wet and dry years (50 cfs or more).

If accidental agricultural runoff should occur, the maximum flow will be 0.1 cfs (34,000 gallons discharged over 12 hours) and therefore streambank erosion or flooding impacts will be less than significant.

No Impact; Alternatives 1, 4 and 5.

These alternatives do not have an agricultural irrigation component.

Mitigation: No mitigation is proposed.

Geysers Steamfield Component

Impact: **4.8.1-7. Will the geysers steamfield component impact surface water hydrology based on evaluation criteria 1 through 7?**

Analysis: *No Impact; All Alternatives.*

The geysers steamfield component of Alternative 4 will not affect surface hydrology because injected water does not discharge to surface water and no change to existing diversions of surface water will result from the Project.

Alternatives 1, 2, 3, and 5 do not have a geysers steamfield component.

Mitigation: No mitigation is needed.

Discharge Component

Table 4.4-13

Hydrology Impacts by Component - Discharge

Evaluation Criteria	As Measured by	Impact	Type of Impact[1]	Level of Significance[2]
4.9.1. Will the discharge component discharge reclaimed water to the Laguna de Santa Rosa causing streambank erosion in the Laguna de Santa Rosa?	Greater than 2 percent increase of the average stream power of the Laguna when the average channel velocity exceeds 3 fps in the Laguna	Less than 2 percent increase	O&M O&M-CP	❍ ❍

Table 4.4-13

Hydrology Impacts by Component - Discharge

Evaluation Criteria	As Measured by	Impact	Type of Impact[1]	Level of Significance[2]
4.9.2. Will the discharge component discharge reclaimed water to the Laguna de Santa Rosa or the Russian River causing streambank erosion in the Russian River?	Greater than 2 percent increase of the average stream power when the average channel velocity exceeds 4 fps in the Russian River	Less than 2 percent increase	O&M O&M-CP	O O
4.9.3. Will the discharge component discharge reclaimed water to the Laguna de Santa Rosa causing flooding anywhere along the Laguna de Santa Rosa?	Greater than 0.1-foot increase of the 100-year flood elevation	No change from existing	O&M O&M-CP	== ==
4.9.4. Will the discharge component discharge reclaimed water causing an increase in the maximum flood elevation in the Russian River?	Greater than 0.1-foot increase of the water surface elevation in the Russian River at the USGS Guerneville gage during flood stage	0.015 foot increase	O&M O&M-CP	O O
4.9.5. Will non-discharge components cause flooding?	Greater than 0.1-foot increase of the peak water surface elevation	--	O&M	--
4.9.6. Will non-discharge component cause streambank erosion?	Greater than 2 percent increase of the average power in the stream	--	O&M	--
4.9.7. Will the discharge component cause flooding due to rupture of pipelines?	If release of water exceeds the capacity of local waterway during normal flow conditions	--	O&M	--

Source: Merritt Smith Consulting, 1996

Notes: 1. Type of Impact:
- O&M Operation and Maintenance
- O&M-CP Operation and Maintenance Contingency Plan
- -- Not Applicable

2. Level of Significance:
- == No impact
- O Less than significant impact; no mitigation proposed

Impact: 4.9.1. Will the discharge component discharge reclaimed water to the Laguna de Santa Rosa causing streambank erosion in the Laguna de Santa Rosa?

Analysis: *Less than Significant; Alternatives 1 and 5B.*

When the Laguna is flowing at more than 3 feet per second, stream power will increase by less than two percent due to discharge of reclaimed water at the Laguna (Dames and Moore 1995b). Contingency discharges will not cause significant streambank erosion because they will occur only when flows are very low and velocity is less than 3 feet per second in the Laguna and Russian River.

No Impact; Alternatives 2, 3, 4, and 5A.

These alternatives involve less discharge, and therefore less erosion potential than existing conditions.

Mitigation: No mitigation is proposed.

Impact: 4.9.2. Will the discharge component discharge reclaimed water to the Laguna de Santa Rosa or the Russian River causing streambank erosion in the Russian River?

Analysis: *Less than Significant; Alternatives 1 and 5.*

When the Russian River is flowing at more than 4 feet per second, stream power will increase by less than two percent due to discharge of reclaimed water at either the Russian River or the Laguna (Dames and Moore 1995b). Design criteria of the Russian River outfall (Alternative 5A) include energy dissipation such that localized erosion is considered less than significant. Contingency discharges will not cause significant streambank erosion because they will occur only when flows are very low and the velocity is less than 4 feet per second in the Laguna and Russian River.

No Impact; Alternatives 2, 3 and 4.

Alternatives 2, 3 and 4 involve less discharge, and therefore less erosion potential than existing conditions.

Mitigation: No mitigation is proposed.

Impact: 4.9.3. Will the discharge component discharge reclaimed water to the Laguna de Santa Rosa causing flooding anywhere along the Laguna de Santa Rosa?

Analysis: *No Impact; All Alternatives.*

Discharge proposed to the Laguna occurs at Meadowlane Pond and Delta Pond. The factor limiting the quantity of reclaimed water that can be discharged during flood events is not the 1 or 20 percent design discharge rates that are associated with Project alternatives. Rather, the hydraulic restrictions inherent in the reclaimed water pumps and pipes limit discharge rates to much less than 1 percent when high water conditions occur in the Laguna. Thus the potential discharge volume during flood or

near-flood condition (and therefore the potential impact on flooding) under all the existing condition and under alternatives is identical. Therefore, the discharge associated with all alternatives is considered to have no impact. The impact of the existing condition and the potential impact of these alternatives is described in the following paragraph.

Discharge from Delta Pond during a flood event is not possible because the water surface elevation in the Laguna is higher than that in Delta Pond and discharge from Delta Pond occurs by gravity (discharge is not pumped). The operating level of Meadowlane Pond is 94 feet above sea level, which is higher than the 100-year flood elevation at that location. Thus, gravity discharge from Meadowlane Pond is possible during flood conditions, and the maximum discharge rate from Meadowlane Pond is approximately 62 mgd or 95 cfs, 49 cfs by gravity and 46 cfs by pump. This represents the discharge capacity under existing conditions and under Alternatives 1, 2, 3, 4, and 5B. A discharge of 95 cfs from Meadowlane during the 100-year flood event would raise the water surface elevation by a maximum of 0.015 feet at any place in the Laguna. The effect of a 95 cfs discharge from Meadowlane during a prolonged (2-day) flood event is less than 0.1-foot increase in the Laguna. This analysis is summarized in Potential Flood Impacts, Laguna de Santa Rosa Floodplain and Russian River Floodplain (Dames and Moore 1996b).

Contingency discharges will not cause significant flooding because they would occur only when flows are low in the Laguna.

Mitigation: No mitigation is proposed.

Impact: **4.9.4. Will discharge component discharge reclaimed water causing an increase in the maximum flood elevation in the Russian River?**

Analysis: *Less than Significant; Alternative 5A.*

Alternative 5A could involve the addition of discharge capacity under flood or near-flood conditions. The Russian River outfall will have a capacity of 775 MG/month or 40 cfs in addition to the existing discharge capacity of 95 cfs. During flood stage (32 feet local datum, 39,530 cfs) a 40 cfs discharge will raise the water surface elevation at the USGS Hacienda Gage by 0.015 feet. Since the point of significance is 0.1 feet, this impact is considered less than significant. This analysis is summarized in *Potential Flood Impacts, Laguna de Santa Rosa Floodplain and Russian River Floodplain* (Dames and Moore 1996b).

No Impact; Alternatives 1, 2, 3, 4, and 5B.

As described above for impact 4.9.3, all Laguna discharge components will have the same impact on flooding in the Russian River as does discharge under the existing condition. Thus, all Laguna discharge components are considered to have no impact on Russian River flooding.

The impact of existing discharges and the impact under all Laguna discharge scenarios is described in the following paragraph.

The effect of 95 cfs on water surface elevation at the Hacienda gage at flood stage (32 feet local datum, 39,530 cfs.) will be an increase of 0.038 feet to 32.038 feet (Dames and Moore 1996b), which is less than the 0.1 foot significance criterion.

Contingency discharges will not cause significant flooding because they would occur only when flows are low in the Russian River.

Mitigation: No mitigation is proposed.

Impact: **4.9.5-7. The discharge component is not applicable to evaluation criteria 5, 6 and 7.**

CUMULATIVE IMPACTS

Impact: **4.1 and 2C. Will the Project plus cumulative projects cause streambank erosion in the Laguna de Santa Rosa or the Russian River?**

Analysis: None of the Project alternatives will have a significant impact on streambank erosion. The 20 percent discharge alternatives (Alternative 5A and 5B) contribute a minor, less than significant, impact to streambank erosion in the Laguna and Russian River, whereas some alternatives involve reduced discharge relative to existing conditions (Alternatives 2, 3 and 4). The No Action (Alternative 1) discharge involves increase discharge relative to existing conditions but less discharge than Alternative 5. A streambank erosion impact results when increased reclaimed water discharge increases the velocity of the waters in the Laguna or Russian River.

Several gravel extraction projects have been identified upstream on the Russian River, and gravel extraction has been identified by the Sonoma County Aggregates Management Plan as causing long-term alteration of the bed of the Russian River. Streambank impacts from gravel extraction occur, however, not from increasing the velocity of water, because in general they serve to flatten out the riverbed or reduce the elevation differential between upstream and downstream portions of the river. Therefore, according to the evaluation criteria for streambank erosion, gravel projects do not contribute to the cumulative impacts of the Long-Term Project, because they do not increase the velocity of the river flow.

Other potential cumulative projects are the expansion of other sewage treatment plants which discharge into the Laguna or Russian River. The expansion plans of these plants contribute very small amounts compared to the Long-Term Project and therefore affect the velocity of water flow

very little. The contribution of the other sewage treatment plants would not cause the total increase in velocity to exceed 1 percent of flow in the Laguna or Russian River, the point of significance.

Impact: **4.4C. Will the Project plus cumulative projects cause flooding in the Russian River.**

Analysis: The Russian River discharge alternative will increase flood elevation in the Russian River by a maximum of 0.015 feet. The incremental flow from other sewage treatment plants is estimated in Table 4.6-50 to be no greater than 11.8 cfs. Actual discharge will be less than 11.8 cfs because some of the flow identified in Table 4.6-50 as incremental flow will be irrigated instead of discharged (e.g. Town of Windsor). According to the *Potential Flood Impacts Laguna de Santa Rosa Floodplain and Russian River Floodplain* technical report (Dames and Moore 1996b), 11.8 cfs incremental flow at flood stage will increase water depth approximately 0.003 feet. Thus, the total increased elevation (0.018 feet) will not exceed 0.1 feet, the point of significance.

Appendix D-31 identifies population growth and property development in communities in the Russian River watershed. Population growth and property development will result in increased amount of impermeable surface and therefore increased runoff. The increased runoff due to development combined with the 0.015-foot increase resulting from discharge associated with Alternative 5A is assumed to exceed the 0.1-foot point of significance. Thus, the cumulative impact of discharge on flooding is considered significant.

Mitigation: *Alternative 5A.*

2.5.10. Discharge Prohibition During Flood Stage

Impact: **4.5C. Will the Project plus cumulative projects cause flooding in streams?**

Alternative 2 and 3 (storage reservoirs).

Analysis: Reservoirs will reduce the peak flood elevation in streams located downstream of reservoirs. Therefore, no cumulative impacts with respect to storage-related flooding are expected to occur.

Alternatives 2B, 2C, 2D, and 3 (agricultural irrigation).

The impact on flooding of Project irrigation is considered to be less than significant. Projects listed in Appendix D-31 will not affect the hydrologic regime in streams potentially affected by irrigation. Therefore, no cumulative impacts with respect to irrigation-related flooding are expected to occur.

Impact: **4.6C. Will the Project plus cumulative projects cause streambank erosion?**

Analysis: All Reservoirs.

This is a localized impact limited to the first several hundred feet of the streams directly below dams where diversion and spillway structures are proposed. No cumulative projects have been identified on the drainages downstream of these dams that could contribute to further erosion of the streambank. Therefore, no cumulative impacts with respect to storage-related erosion are expected to occur.

Alternatives 2B, 2C, 2D, and 3 (agricultural irrigation).

The impact on streambank erosion of Project irrigation is considered to be less than significant. Projects listed in Appendix D-31 will not affect the hydrologic regime in streams potentially affected by irrigation. Therefore, no cumulative impacts with respect to irrigation-related erosion are expected to occur.

Impact: **4.7C. Will the Project plus Cumulative projects cause flooding due to rupture of pipelines?**

Analysis: The impact on flooding of Project pipeline ruptures is considered to be less than significant. Projects listed in Appendix D-31 would not affect the hydrologic regime in streams potentially affected by a pipeline rupture. Therefore, no cumulative impacts with respect to pipeline rupture-related flooding are expected to occur.

SUMMARY OF SIGNIFICANT IMPACTS AND MITIGATION MEASURES

Table 4.4-14

Summary of Significant Impacts and Mitigation Measures - Air Quality

Impact	Level of Significance	Mitigation Measure
Cumulative Impacts		
4.4C. The Project plus cumulative projects may cause flooding in the Russian River.	Alt. 5A - ⊙	2.5.10. Discharge Prohibition During Flood Stage

Source: Harland Bartholomew & Associates, Inc. 1996

Notes:
⊙ Significant impact before mitigation; less than significant impact after mitigation

SUMMARY OF IMPACTS BY ALTERNATIVE

Table 4.4-15

Summary of Impacts by Alternative -Surface Water Hydrology

Component	Alt 1	Alt 2A	Alt 2B	Alt 2C	Alt 2D	Alt 3A	Alt 3B	Alt 3C	Alt 3D	Alt 3E	Alt 4	Alt 5A	Alt 5B
No Action (No Project) Alternative	○	--	--	--	--	--	--	--	--	--	--	--	--
Headworks Expansion	--	==	==	==	==	==	==	==	==	==	==	==	==
Urban Irrigation	--	==	==	==	==	==	==	==	==	==	--	--	--
Pipelines	--	○	○	○	○	○	○	○	○	○	○	==	--
Storage Reservoirs	--	○	○	○	○	○	○	○	○	○	--	--	--
Pump Stations	--	==	==	==	==	==	==	==	==	==	==	--	--
Agricultural Irrigation	--	○	○	○	○	○	○	○	○	○	--	--	--
Geysers Steamfield	--	--	--	--	--	--	--	--	--	--	==	--	--
Discharge	--	==	==	==	==	==	==	==	==	==	==	○	○
Cumulative	==	==	==	==	==	==	==	==	==	==	==	⊙	==

Source: Harland Bartholomew & Associates, inc. 1996

Notes: Level of Significance

- -- Not applicable
- ⊙ Significant impact; less than significant after mitigation
- == No impact
- ○ Less than significant impact; no mitigation proposed
- ● Significant impact before and after mitigation

PREPARERS, REFERENCES, AND CONSULTATION AND COORDINATION

Preparers

David W. Smith, Ph.D., Merritt Smith Consulting
Glenn Dearth, PE, Dames and Moore

Reviewers

Robin Cort, Ph.D., Parsons Engineering Science, Inc.
Anders J. Hauge, Harland Bartholomew & Associates, Inc.
Patricia I. Collins, Harland Bartholomew & Associates, Inc.
Sandia Potter, Parsons Engineering Science, Inc.
John Cummings, Ph.D., Peer Review Committee
David Ziegler, Peer Review Committee

References

HBA Team Documents

Dames & Moore. 1995a. *Reservoir Spillway Hydrology Analysis.* (Appendix D-16).

Dames & Moore. 1995b. *Potential Streambank Erosion Laguna de Santa Rosa and Russian River.* (Appendix G-2).

Dames & Moore. 1996a. Dam Break Inundation Analysis. (Appendix J-1).

Dames & Moore. 1996b. *Potential Flood Impacts. Laguna de Santa Rosa Floodplain and Russian River Floodplain.* (Appendix G-1).

Dames & Moore. 1996c. *Reservoir Inflow Analysis.* (Appendix D-15).

Merritt Smith Consulting. 1996a. *Aquatic Biological Resources Impact Analysis Report.* (Appendix L-7).

Merritt Smith Consulting. 1996b. *Aquatic Habitat Impacts Analysis.* (Appendix L-4).

Merritt Smith Consulting. 1996c. *Water Quality Impacts Analysis Report Volume I.* (Appendix I-16)

Questa Engineering Corporation, Inc.. 1996. *Baseline Hydrology and Irrigation Drainage Evaluation for West and South County Reclamation Alternatives.* (Appendix I-10).

Resource Management Associates (RMA). 1996. *Russian River Quality Model.* (Appendix I-8).

Other References

Dames & Moore. 1988a. *Hydrologic Evaluation for Wastewater Reclamation Alternative Study, Santa Rosa Subregional Water Reclamation System, Technical Memorandum No. L-3, Monthly Streamflows for Laguna de Santa Rosa.* December 30.

Dames & Moore. 1988b. *Hydrologic Evaluation for Wastewater Reclamation Alternative Study, Santa Rosa Subregional Water Reclamation System, Technical Memorandum No. E-6, Monthly Streamflows for Americano and Stemple Creeks.* December 30.

Smith D.R. and Smith D.W. 1990. *Santa Rosa Subregional Water Reclamation System, Technical Memorandum No. E-9, Water Quality Model.*

Sonoma County Water Agency. 1980. *Russian River Water Plan.*

Sonoma County Water Agency. 1996. *Draft November 16, 1994. Russian River System Model, A Water Balance Computer Model of the Russian River System.* Revised March 1996.

State of California Department of Water Resources. 1994. *California Water Plan Update, Bulletin 160-93.* October.

United States Geological Survey. Word Wide Web address: http://H2O.usgs.gov//swrlcc.

Consultation and Coordination

Persons Contacted

Jim Flugum, P.E., Sonoma County Water Agency

Correspondence

None

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

4.5 GROUNDWATER

This section discusses the Project impacts on groundwater quality at existing and future drinking water wells, the potential for groundwater mounding or increase in groundwater levels that could cause surface water discharge in a non-stream environment, and the potential to lower groundwater levels at existing and potential future wells. To allow evaluation of these impacts, geologic units in the area are described and identified as to their water-yielding properties. Groundwater basins in the Project area are depicted, and the groundwater conditions at irrigation areas and storage sites are presented. Regional groundwater quality and reclaimed water quality are described.

IMPACTS EVALUATED IN OTHER SECTIONS

The following items are related to the Groundwater Section but are evaluated in other sections of the document:

- Subflow Resulting from Irrigation with Reclaimed Water. Impacts are evaluated in Section 4.6, Surface Water Quality and Section 4.9, Aquatic Biological Resources.
- Surface Water Discharge in a Stream Environment. This impact is evaluated in Section 4.6, Surface Water Quality.
- Groundwater Quality and Reclaimed Water Quality in Relation to Drinking Water Standards. These issues are evaluated in Section 4.7, Public Health and Safety.

AFFECTED ENVIRONMENT (SETTING)

Concepts of Groundwater Hydrology

The following section provides a summary of the basic concepts of groundwater hydrology. The material has been summarized from the Evaluation of Groundwater Resources: Sonoma County (California State Department of Water Resources 1975) and focuses on processes relevant to the Project impact evaluation.

Water is present in two zones beneath the ground surface. The upper zone is the zone of aeration (or vadose zone) where pore spaces in the geologic material are partly filled with air and partly filled with water. Wells do not produce groundwater from the vadose zone because the molecules of water adhere tightly to the various geologic materials. Water stored in this zone of aeration is called soil moisture or vadose water. Soil moisture is drawn into the rootlets of growing plants. As the plants use the water, it is transpired as vapor to the atmosphere. Under some conditions, water can flow laterally in the vadose zone in a process known as interflow (Fetter 1994).

If perched groundwater occurs in the zone of aeration, it is contained in an isolated saturated zone which occurs above a low permeability layer and is separated from the

main groundwater body by an underlying unsaturated zone. The lower zone is the zone of saturation where all of the interconnected pore spaces in the geologic material are filled with groundwater, and only dissolved gaseous air is present.

Groundwater in the saturated zone is either confined or unconfined. An aquifer containing unconfined groundwater is one that is not overlain by a confining bed of relatively low permeability geologic material. The upper surface of an unconfined body of groundwater is called the water table. It is represented by the level of water in a well penetrating the saturated zone. In an unconfined aquifer the water table is assumed to be connected to the atmosphere through openings in the overlying material.

A confined aquifer is overlain by relatively impermeable material and is isolated from overlying aquifers except in areas of recharge. Groundwater contained in confined aquifers is under pressure, and the level to which the water will rise in a nonpumping well is the potentiometric surface of the groundwater. The potentiometric surface is an imaginary surface that represents the upward pressure exerted by the confined groundwater on the materials overlying it.

Water recharges an aquifer through precipitation, streamflow, irrigation, or other sources by entering the ground and moving downward through the zone of aeration and into the zone of saturation. Groundwater under pressure moves toward areas of lower pressure, such as pumping depressions. In cases where the pressure relief area is along a stream channel, springs form and provide streamflow even during periods of low precipitation.

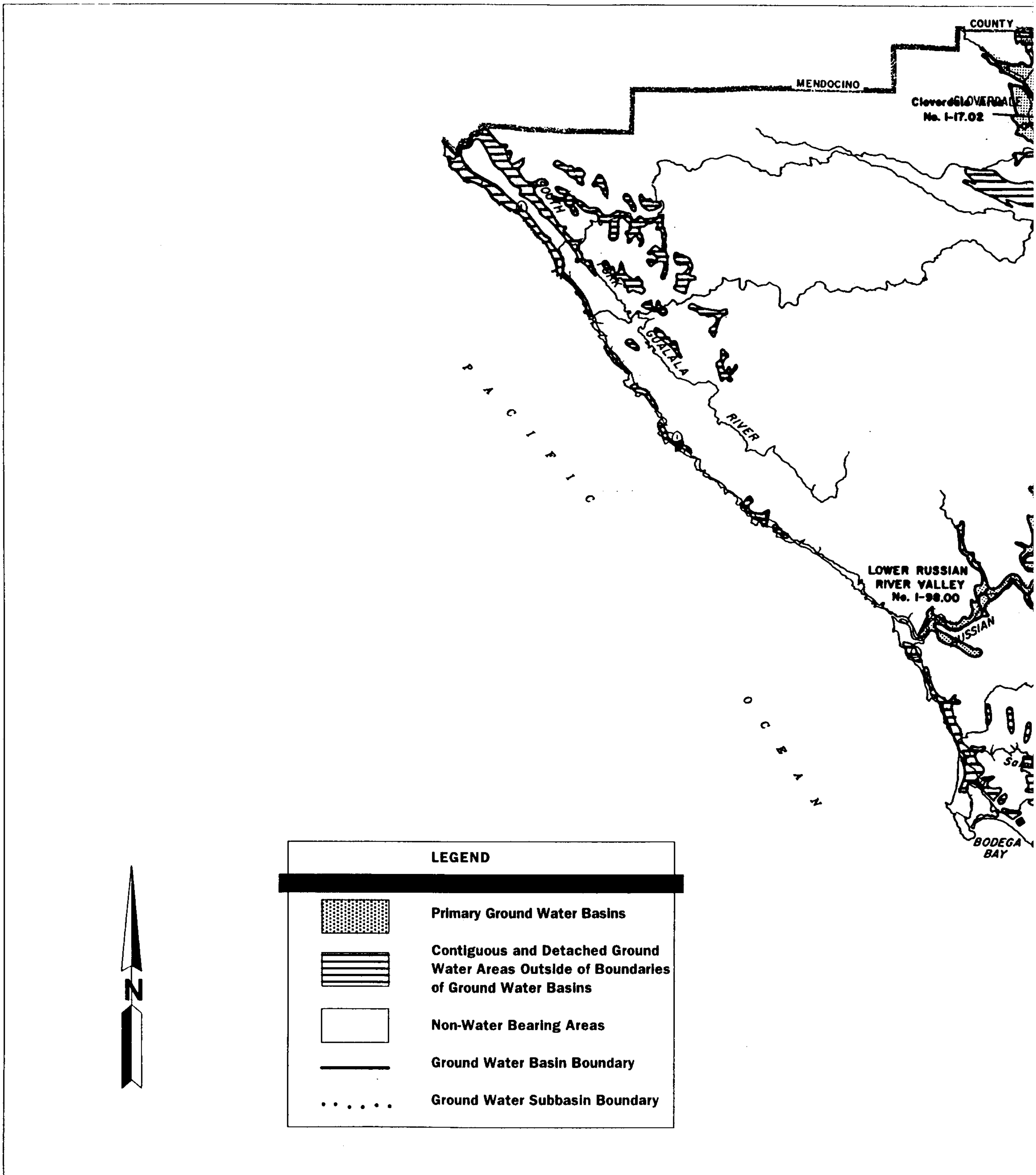
The general groundwater movement pattern of a basin can be interpreted from groundwater contour maps[1] which show lines of equal elevation of the groundwater surface. Groundwater movement is perpendicular to the contour lines and moves from the higher elevation contours to the lower. The relative spacing between the contour lines indicates the hydraulic gradient of the groundwater, which is an index of the resistance encountered as the water moves through the various permeable layers.

Regional Groundwater

Sonoma County has been divided into three groundwater resource regions (Figure 4.5-1). One region contains the seven valley groundwater basins: Santa Rosa, Petaluma, Sonoma, Alexander, Kenwood, Knights, and Lower Russian River valleys (Figure 4.5-1) (California State Department of Water Resources 1975). A groundwater basin is an area that is underlain by water-bearing materials and has significant potential for groundwater development.

[1] Groundwater contour maps should not be confused with topographic maps which show ground surface topography by mapping lines of equal elevation. Although groundwater in an unconfined aquifer may mimic topography, groundwater basins and flow directions are controlled by the groundwater gradient that may or may not reflect topography.

(1)



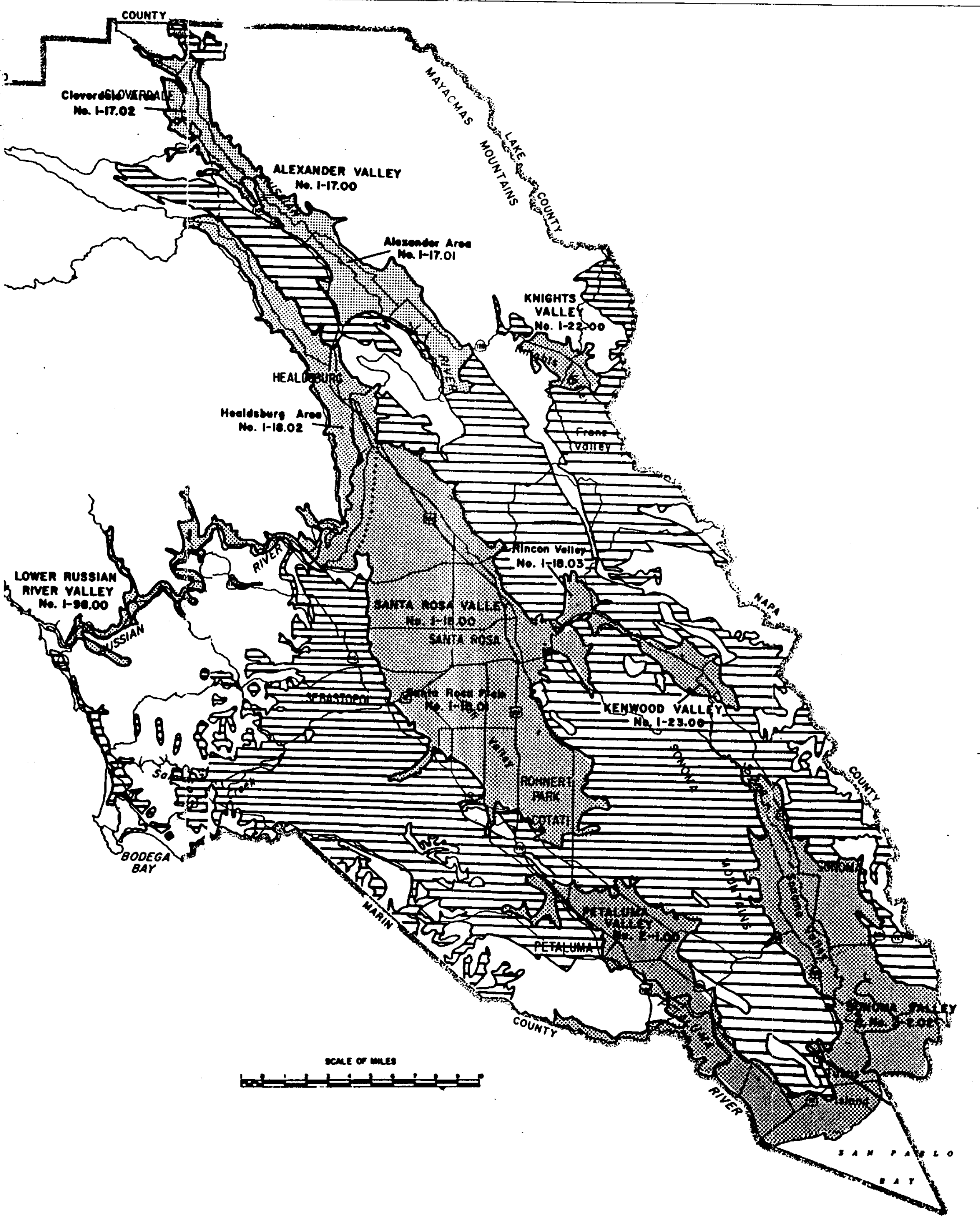
Source: Department of Water Resources 1975

HARLAND BARTHOLOMEW & ASSOCIATES, INC.
PARSONS ENGINEERING SCIENCE, INC.
UNITS OF PARSONS INFRASTRUCTURE & TECHNOLOGY INC.

PARSONS

Santa Rosa

(2)

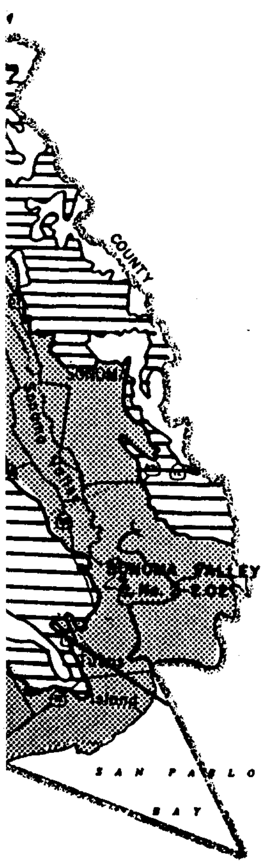


Santa Rosa Subregional Long-Term Wastewater Project

GROUNDWATER BASINS in SONOMA COUNTY

Fi

3



GROUNDWATER BASINS in SONOMA COUNTY

Figure 4.5-1

Groundwater is usually available in predictable quantities nearly everywhere within the limits of the groundwater basin. The second important groundwater region in Sonoma County is the contiguous and detached groundwater areas which are located in upland areas of Sonoma and northern Marin counties. These areas are underlain by a variety of geologic materials which range in their water-yielding capabilities from high yield in the case of the Wilson Grove Formation to low yield in the case of Petaluma Formation. The third area is underlain by non-water-bearing rock and is not considered to be a predictable source of groundwater. Occasional wells may be developed in these areas yielding supplies of groundwater adequate for most domestic or stock applications.

The following description of environmental setting and impacts pertains to two groundwater basins (the Santa Rosa Plain and the Petaluma Valley), several areas of contiguous and detached groundwater in Sonoma and Marin counties (west county irrigation and reservoir sites, Sebastopol irrigation area, and portions of the urban irrigation areas), and areas of non-water bearing rock (the geysers and portions of the Tolay Creek watershed). Descriptions are based on various reports by the California State Department of Water Resources (1975, 1982a and b, 1987), which are the most current compilations of regional groundwater information. Groundwater field investigations confirmed that these sources provide valid information for characterizing the Project area.

Groundwater recharge in Sonoma and northern Marin counties generally occurs in upland areas adjacent to groundwater basins. The primary sources of recharge are precipitation and stream seepage. Recharge occurs in significant quantities wherever permeable materials are near the surface and connect with the principal groundwater body, and surface slopes are gentle enough to limit the amount of precipitation that becomes surface runoff.

Groundwater discharge occurs mostly along the major trunk streams of the Santa Rosa and Petaluma valleys. In these areas, groundwater discharges as underflow to the streams, Laguna, or adjacent low-lying areas. This water then flows as surface water toward the Russian River or San Pablo Bay. Groundwater is also lost through evapotranspiration in the extensive marsh areas of the Laguna de Santa Rosa. In the western uplands, groundwater discharges to streams in the middle to lower reaches of coastal valleys. These streams discharge to the estuaries on the coast. Water extracted from wells also contributes to removal of groundwater from the basins.

In general, the water table surface mirrors topography, although in a more subdued form. Unconfined groundwater elevations are highest at topographic high areas, and low in the lower topographic areas.

Hydrogeologic Units

Groundwater within the study area occurs in a complex system of highly variable geologic units. These units are commonly divided into non-water-yielding, variable water-yielding, and water-yielding groups. A measure of the water-yielding capacity of

the geologic units is the specific yield,[2] often expressed as a percentage. The units are listed in the sequence in which they occur from lowest (oldest) to highest (youngest) (Parsons Engineering Science, Inc. 1996a).

Franciscan Complex (Jurassic-Cretaceous): Basement rocks consist of the Franciscan Complex, the oldest geologic unit within the project area. This unit consists chiefly of sandstone, shale, chert, greenstone, and serpentinite. Sandstone is the predominant rock type of the formation but large areas consist of rock melange, a mixture of broken rock masses in a sheared matrix of shale.

In the northwest trending valley that forms the Santa Rosa/Petaluma trough, bedrock of the Franciscan Complex is downwarped and is buried by thick sequences of sedimentary rock and unconsolidated sediment. In the western uplands, Franciscan bedrock is exposed at the surface or capped by a relatively thin veneer of sedimentary rock.

Rocks of the Franciscan Complex are generally non-water yielding because they are well consolidated and dense. However, zones of secondary porosity caused by joints, fractures or shear zones may locally provide low yields of water. In the Santa Rosa/Petaluma trough, the Franciscan Complex is relatively deep and generally not used as a groundwater resource. In the western uplands where the Franciscan occurs at or near the surface, small amounts of water may be obtained from water yielding zones. Well yields in the Franciscan Complex are generally low. The California State Department of Water Resources (1975) has attributed a very low specific yield of less than 3 percent to these rocks.

Petaluma Formation (late Miocene [Fox 1983]): The Petaluma Formation consists of folded terrestrial and brackish water deposits composed of clay, shale, sandstone with lesser amounts of conglomerate, and limestone. Clay is the predominant rock type of the formation.

The Petaluma Formation overlies Franciscan bedrock in a major portion of the Petaluma and Santa Rosa valleys and is overlain by and locally interfingers with the Wilson Grove Formation. The Petaluma Formation occurs along the eastern margin of the Santa Rosa/Petaluma trough where the deposits locally interfinger with and are overlain by, or in fault contact with the Sonoma Volcanics (Cardwell 1958, Fox 1983). In the central to western Petaluma Valley, northwest trending faults mark abrupt contacts between the Petaluma and Wilson Grove formations. The Petaluma Formation has a maximum thickness of 4,000 feet.

Groundwater occurs in the sandstone and conglomerate lenses that are interspersed in the predominant claystone of the Petaluma Formation. Where appreciable thicknesses of coarse-grained material are encountered, this formation can yield moderate amounts of water adequate for domestic needs, though because of the predominance of claystone, well yields are generally low (Cardwell 1958). Specific yields for this unit are low, from 3 to 7 percent (California State Department of Water Resources 1987).

2 Specific yield is defined as the ratio of the volume of water that a given mass of saturated rock or soil will yield (under gravity) to the volume of that mass.

Wilson Grove Formation (Late Miocene to Pliocene [Fox 1983]): The Wilson Grove Formation (formerly referred to as the Merced Formation) is one of the principal water-producing formations in Sonoma County. The formation consists of massive beds of fine- to very fine-grained marine sandstone with interbeds of clay and gravel.

The lowermost Wilson Grove Formation overlies and interfingers with the Petaluma Formation in the central portion of the Santa Rosa/Petaluma trough. On the western side of the trough the formation lies directly on Franciscan bedrock. The Wilson Grove Formation thins east of the central portion of the trough and does not extend to the eastern margin. The formation is exposed in the hills on the west side of the trough and is overlain by alluvial fan deposits in the Santa Rosa and Petaluma valleys. The formation's thickness below the Santa Rosa Plain may be as great as 800 feet. In the Petaluma Valley the maximum thickness is about 200 feet (Cardwell 1958).

In the western portion of Sonoma County, the Wilson Grove Formation forms a relatively thin veneer overlying Franciscan Complex rocks. On the topographically higher ridges the formation occurs as isolated caps on Franciscan rocks.

Groundwater in the Wilson Grove Formation is typically unconfined, but semi-confined or confined conditions can occur locally wherever laterally continuous clay beds occur. Because of its uniform high porosity and moderate permeability, this unit yields good quantities of water (Cardwell 1958). The Wilson Grove Formation has high specific yields of 10 to 20 percent (California State Department of Water Resources 1987).

Sonoma Volcanics (late Miocene to Pliocene [Fox 1983]): The Sonoma Volcanics are a thick sequence of volcanic material consisting of lava flows, tuffs and intrusive rocks (California State Department of Water Resources 1975). Locally, the volcanics interfinger with the Petaluma and Wilson Grove formations. The Sonoma Volcanics border the eastern edge of the Santa Rosa Plain and extend under the plain a short distance. In the vicinity of Petaluma Valley the volcanics are mainly restricted to the hills east of the valley. Few exposures of the volcanics occur in the western portion of the county. Productivity of water wells within this unit is highly variable, ranging from dry wells to wells with yields that are adequate for domestic purposes. Some of the better producing wells may yield 10 to 50 gallons per minute with drawdowns of 10 to 120 feet (California State Department of Water Resources 1975). Specific yields range from 0 to 15 percent (California State Department of Water Resources 1982).

Alluvial Fan Deposits (Pliocene to Recent). The alluvial fan deposits, which include the Glen Ellen Formation, are composed of a heterogeneous mixture of unconsolidated gravel, sand, silt, and silty clay. The alluvial fan deposits extend from the base of upland areas to the valley floors. The deposits are coarser in upland areas and are finer-grained in the valley. These deposits cover much of the Santa Rosa Plain and the northern and eastern portions of the Petaluma Valley and range in thickness from about 50 to 400 feet (California State Department of Water Resources 1982a, 1982b). Due to their overall coarseness, these deposits are estimated to have moderate to high specific yields of 8 to 17 percent (California State Department of Water Resources 1982a, 1982b).

Alluvium (Pleistocene to Recent). A variety of unconsolidated alluvial deposits occur as discontinuous interbeds of gravel, sand, silt, and clay. These undifferentiated alluvial deposits represent a mixture of coarse-grained stream channel and natural levee deposits, and fine-grained flood plain deposits. In upland areas surrounding the Santa Rosa/Petaluma trough and in the western uplands, alluvium occurs as superficial deposits along narrow bedrock stream valleys. Where streams emerge from upland areas, alluvium is restricted to elongate stream valleys that have been incised into underlying alluvial fan deposits. The specific yield is variable, depending on the amount of clay and the thickness of the deposits. Most deposits are less than 100 feet thick with variable specific yields, ranging from 3 to 15 percent (California State Department of Water Resources 1982a, 1982b).

Basin Deposits (Pleistocene to Recent). Basin deposits consist of organic-rich, clay and silty clay deposited in freshwater marsh and lakes. These deposits occur in low-lying areas of the Santa Rosa Plain including the central portion of the southern plain, adjacent to the Laguna de Santa Rosa and the lower reaches of tributary stream valleys. These thin deposits overlie and interfinger laterally with coarser-grained alluvial fan deposits or alluvium (California State Department of Water Resources 1982b).

The fine-grained basin deposits have low permeability and do not yield significant quantities of groundwater. They restrict infiltration and downward percolation of water and form a confining layer where they overlie coarse-grained, water-yielding deposits. These deposits have been assigned low specific yields of 3 to 7 percent (California State Department of Water Resources 1982b).

Bay Mud Deposits (Pleistocene to Recent). The bay mud deposits consist of organic-rich mud, silty mud, silt and some sand. These sediments cover much of the southern Petaluma Valley. Groundwater occurring in bay mud deposits is brackish to highly saline. Bay muds have a low permeability due to the overall fineness of these deposits. These deposits have been given a very low specific yield of less than 3 percent (California State Department of Water Resources 1982a). The deposits are not considered a reliable source of potable water.

Groundwater Basins

Project components are located throughout Sonoma and northern Marin counties. Some are located in well defined groundwater basins, some in contiguous detached sub-basins, and some in upland areas that are not within defined groundwater basins. Table 4.5-1 provides a summary of groundwater conditions at irrigation areas and storage reservoir sites.

Table 4.5-1

Groundwater Conditions at Reservoir Sites and Irrigation Areas

Project Component	Groundwater Basin	Hydrogeologic Unit/ Presence of Springs	Typical Depth to Ground-Water	Approximate Flow Direction	Ground-water Quality	Approximate Number of Wells[1]
Urban Irrigation	Santa Rosa Plain	Alluvial Fan Deposits	~100'	West	Good	N/A
Sebastopol Agricultural Irrigation	Detached sub-basin of the Santa Rosa Plain	Wilson Grove Formation	20'-80'	North	Good	N/A
Stemple Agricultural Irrigation	Stemple Creek Detached sub-basin	Wilson Grove Formation and Franciscan Complex	10' - 100'	West	Problems with nitrate	N/A
Americano Agricultural Irrigation	Americano Creek Detached sub-basin	Wilson Grove Formation	10' - 40'	West	Good	N/A
North of Petaluma Agricultural Irrigation	Petaluma Valley	Petaluma Formation and Alluvial Fan Deposits	10' - 20'	Southeast	Problems with nitrates	N/A
East of Rohnert Park/Adobe Road Agricultural Irrigation	Santa Rosa Plain/Petaluma Valley	Alluvial Fan deposits and Petaluma Formation	10'-60'	West	Good	N/A
Lakeville/bay flats Agricultural Irrigation	Petaluma Valley	Petaluma Formation and Alluvial Fan Deposits	0' - 150'	South southeast	Brackish water	N/A
Tolay Reservoir	Detached sub-basin	Alluvium, Sonoma Volcanics, Petaluma Formation; Several springs mapped	20' - 60'	Southeast	No data available, likely to be similar to Petaluma	0

Table 4.5-1

Groundwater Conditions at Reservoir Sites and Irrigation Areas

Project Component	Groundwater Basin	Hydrogeologic Unit/ Presence of Springs	Typical Depth to Ground-Water	Approximate Flow Direction	Ground-water Quality	Approximate Number of Wells[1]
Adobe Road Reservoir	Petaluma Valley	Alluvium, Sonoma Volcanics, Petaluma Formation; Several springs mapped	10'-120'	Southwest	Elevated nitrate levels	20
Lakeville Reservoir	Petaluma Valley	Alluvium, Petaluma Formation; Several springs mapped	20'-80'	South	Elevated nitrate levels	4
Sears Point Reservoir	Detached sub-basin of the Tolay watershed	Alluvium, Petaluma Formation; Several springs mapped	10' -20'	Southeast	No data available, likely to be similar to Petaluma	1
Two Rock Reservoir	Detached sub-basin of the Stemple Creek watershed	Alluvium, Wilson Grove Formation, Franciscan Complex; Year-round stock ponds indicate springs	0' - 220'	West	Elevated nitrate levels	25
Bloomfield Reservoir	Detached sub-basin of the Americano Creek watershed	Wilson Grove Formation; Numerous springs mapped	10' - 190'	South	Good	3
Carroll Road Reservoir	Detached sub-basin of the Americano Creek watershed	Wilson Grove Formation; Numerous springs mapped	10' - 175'	South	Good	14

Table 4.5-1

Groundwater Conditions at Reservoir Sites and Irrigation Areas

Project Component	Groundwater Basin	Hydrogeologic Unit/ Presence of Springs	Typical Depth to Ground-Water	Approximate Flow Direction	Ground-water Quality	Approximate Number of Wells[1]
Valley Ford Reservoir	Detached sub-basin of the Americano Creek watershed	Wilson Grove Formation; Several springs mapped	10' - 90'	South	Good	4
Huntley Reservoir	Detached sub-basin of the Stemple Creek watershed	Wilson Grove and Franciscan Complex, Springs concentrated along the geo-logic contact	10' - 150'	South	Elevated Nitrate levels	5

Source: Parsons Engineering Science, Inc., 1996

Notes:
1 Based on review of California State Department of Water Resources well records, CH2M Hill (1990) study, and site reconnaissance.

Santa Rosa Plain

The Santa Rosa Plain is the largest groundwater basin in the Project area and is situated in the Coast Ranges geomorphic province in Sonoma County (Figure 4.5-1). The plain lies in a northwest trending structural depression between the Mendocino Range on the west and the Mayacamas and Sonoma mountains on the east. The Santa Rosa Plain is connected to the Russian River plain by a gap in the hills at the northern end of the plain. The Santa Rosa Plain has low relief with an average ground surface elevation of approximately 145 feet above mean sea level (California State Department of Water Resources 1987).

The Santa Rosa Plain is composed of geologic units with variable water-yielding properties. Generally, the stratigraphically lowest water-yielding unit is the Petaluma Formation which reaches thicknesses of 1,000 feet in the central portion of the Plain. The Wilson Grove Formation overlies the Petaluma Formation in the western and central portion of the plain with thicknesses as great as 800 feet. On the eastern margin of the plain, where the Wilson Grove Formation is absent, the Sonoma Volcanics locally overlie and interfinger with the Petaluma Formation.

Unconsolidated alluvial fan deposits[3] up to 500 feet thick, form the uppermost geologic unit over much of the Plain. A variety of younger alluvial material composed of clay, silt, sand, and gravel forms discontinuous deposits on or near the surface of the Plain. Relatively small, thin patches of fine-grained marsh-like deposits classified as basin deposits are scattered over the surface of the Plain. The total thickness of deposits in the central portion of the Plain probably exceeds 2,000 feet (California State Department of Water Resources 1982).

In the Santa Rosa Plain the water table is typically shallow (Figure 4.5-3). In the 1950s groundwater levels were generally 5 to 20 feet below the ground surface (Cardwell 1958). Comparison of groundwater contours from 1960 to 1975 indicates that groundwater levels in some areas of the plain have dropped while other areas have risen or remained the same (California State Department of Water Resources 1982). Groundwater levels have risen in the vicinity of Santa Rosa where groundwater use has decreased over this time period. In the southern portion of the plain, groundwater use has increased causing a decline in water levels in that area. Because these variations tend to offset each other, the groundwater basin as a whole is viewed as being in balance (California State Department of Water Resources 1982). Most of the groundwater in this basin appears to be in unconfined aquifers although there is evidence that some deeper portions are under semi-confined to confined conditions (California State Department of Water Resources 1987).

Groundwater in the plain generally moves toward the Laguna de Santa Rosa which is adjacent to and parallel with the western margin of the basin (Cardwell 1958). Therefore, the predominant flow direction is toward the southwest. The primary source of the recharge for groundwater in the Santa Rosa Plain is from infiltration of rainfall and seepage from streams (Cardwell 1958). Recharge is dependent on topography, surface soil conditions, and vegetation.

Groundwater of the Santa Rosa Plain is used for irrigation, domestic, industrial, and municipal water supply. Many wells that serve rural agricultural residential uses are shallow and extract a relatively minor amount of water from the aquifer. These wells are widely distributed in the Santa Rosa Plain.

Industrial and municipal wells tend to be clustered in and around urban areas and extend to depths ranging from 450 to greater than 1,000 feet. The cities of Rohnert Park, Cotati, and Sebastopol and Sonoma State University obtain water from the Santa Rosa Plain groundwater basin. The single largest user of groundwater in the area is the City of Rohnert Park, which operates approximately 40 wells primarily located north and west of the City. Pumping of groundwater for water supply has caused a lowering of the water table in the vicinity of Rohnert Park. In general, however, high groundwater levels in the Santa Rosa Plain indicate that the major portion of the aquifer is at or near its storage capacity.

[3] Most of the geologic units in the Santa Rosa Plain previously mapped as the Glen Ellen Formation are classified as alluvial fan deposits (California Department of Water Resources 1982).

Petaluma Valley

The Petaluma Valley groundwater basin comprises approximately 60,000 acres extending from Penngrove south to the Marin County line and San Pablo Bay. The groundwater basin includes the Two Rock area to the west and extends east to the crest of the Sonoma Mountains, which separates the Petaluma Valley from the Sonoma Valley (Figure 4.5-1).

The Petaluma Valley groundwater basin occurs as a northwest trending trough underlain by the essentially non-water-yielding Franciscan Complex. The two primary water-yielding units are the Wilson Grove Formation and the alluvial fan and alluvium deposits. The Wilson Grove Formation overlies the Franciscan Complex in the west and central portion of the trough. In this basin, the Wilson Grove Formation has a maximum thickness of over 200 feet. The Wilson Grove Formation does not occur at the eastern margin of the basin where the Petaluma Formation, a relatively low water-yielding unit, directly overlies the Franciscan Complex. Alluvial fan deposits and alluvium generally occur at the surface in low-lying portions of the valley and overlie both the Wilson Grove and the Petaluma formations. The alluvial fan and alluvium deposits have a maximum thickness of approximately 100 feet in this basin.

Although the Petaluma Valley is generally considered to be a single groundwater basin, groundwater occurs in vertically and horizontally discontinuous hydrologeologic units. The sands and gravels of the Wilson Grove Formation generally form continuous hydrogeologic units. The other geologic units of the basin generally contain discontinuous coarse-grained lenses. This discontinuity is evidenced by the unique water quality that can be found in relatively isolated hydrogeologic units (California State Department of Water Resources 1982b).

Generally, the groundwater basin is unconfined at shallow depths although semi-confined to confined conditions can be encountered deeper in the basin (Cardwell 1958). The depth to groundwater is shallow, ranging from 10 to 25 feet below the ground surface in the spring to 15 to 40 feet in the autumn (Cardwell 1958). The elevation of the water table in the uplands is higher than in the valley floor area, but usually occurs at depths of 50 to 75 feet below the ground surface.

Groundwater extraction satisfied the City of Petaluma's water needs during the late 1950s and early 1960s. However, problems with salt water intrusion attributed to this municipal use resulted in groundwater pumpage being reduced in 1962 when water deliveries from the Russian River began. In the early 1980s, 15 percent (900 acre-feet/year) of the City of Petaluma's municipal water was supplied by groundwater (California State Department of Water Resources 1982b). The City currently relies on the Sonoma County Water Agency to supply all of its water needs and City wells are not used. Groundwater remains the primary source of domestic and irrigation water needs in the unincorporated areas of Petaluma Valley.

Americano/Stemple Area

The watersheds of Americano and Stemple creeks are located in southwestern Sonoma County and northeastern Marin County. These west-flowing creeks are located in relatively steep terrain, drain directly into the Pacific Ocean, and are not part of the Russian River watershed. Refer to Section 4.4, Surface Water Hydrology, for a discussion of the watersheds of Americano and Stemple creeks.

The Americano/Stemple area is not within a discrete groundwater basin but is considered to be part of the continuous and detached groundwater area (Figure 4.5-1). Three main geologic units, the Franciscan Complex, the Wilson Grove Formation, and alluvium are present in the area; all of these units contain some groundwater and have been developed for water supply to some degree.

In the coastal groundwater basins underlying the watersheds of Stemple and Americano creeks, groundwater moves from upland recharge areas to trunk streams or main branches of the Stemple and Americano creeks. Deeper groundwater flows continue toward the estuaries on the coast. Groundwater seeps typically occur at cliff-face exposures at the contact between the Wilson Grove and the Franciscan Complex.

The Wilson Grove Formation is the major aquifer in the area and includes permeable gravel, shell lenses, and minor layers of fine-grained material. In general, yields from this formation are high (California State Department of Water Resources 1975).

The Franciscan Complex in the Americano/Stemple area is extensively fractured and faulted and can locally provide small amounts of water to wells. Generally, the Franciscan provides only low yields to domestic wells, stock watering wells, and springs. Limited alluvial deposits along the stream valleys provide water to shallow domestic wells.

In the Americano/Stemple area, groundwater in shallow wells is typically less than 30 feet below the ground surface. In wells of intermediate depth (200 to 400 feet), groundwater levels generally range from approximately 20 to 90 feet below the ground surface; wells over 400 feet deep contain water at depths ranging from approximately 50 to 150 feet.

The Americano/Stemple area is characterized by a relatively low density of wells relative to the more intensively developed Santa Rosa Plain and Petaluma Valley; wells in this area tend to be concentrated in valleys between upland areas. These wells, which range in depth from less than 20 feet to about 500 feet, serve domestic and agricultural water users.

Groundwater Quality

Twenty-one monitoring wells were installed in the Project area. Well sites were selected to provide groundwater quality data at each reservoir site and in agricultural irrigation

areas. Two of the wells, one in the Two Rock subbasin and one in the Tolay Creek watershed were dry bore-holes. As a result, no new groundwater quality data were available for the Tolay Creek watershed. Groundwater quality data from the Lakeville Hillside reservoir site were applied to the Tolay Creek watershed because both areas have similar geologic conditions and are located a similar distance from San Pablo Bay. Refer to Figures 4.5-2 through 4.5-10 for groundwater monitoring well locations. Two project technical reports: *Hydrogeology of Storage/Reuse Areas and Evaluation of Potential Impacts to Groundwater* and *Well Installations and Groundwater Monitoring Results* (Parsons Engineering Science, Inc. 1996a and b), contain detailed information about the groundwater investigation.

Because of the relatively small number of wells located in each watershed, groundwater quality data from the wells cannot be viewed as a complete characterization of the range of values that could be encountered in a watershed. The data is useful because it establishes the general groundwater quality and allows comparison of existing groundwater quality at the nine reservoir sites. Groundwater quality, and specifically nitrate concentration, varies substantially from one season to the next and from location to location. Groundwater quality may vary significantly among hydrogeologic units. Therefore, the depth of a well and the screened interval (the portion of the well casing that is perforated and contributes water to the well) will influence groundwater quality. Groundwater, particularly in the shallow zone, may be influenced by agricultural uses of the land. Agricultural use in Sonoma County tends to be most intense in low lying, valley floor areas. Most of the wells installed for this project are located in the axis of the main valley (often the only accessible location) and may not be representative of the reservoir subbasin.

Santa Rosa Plain

The Santa Rosa Plain includes the Rohnert Park irrigation area and urban irrigation areas. Groundwater quality in the Santa Rosa Plain is generally good to excellent, although groundwater tends to be hard with high calcium and magnesium concentrations (City of Santa Rosa and U.S. Bureau of Reclamation 1990). Data from the project groundwater sampling program indicate that the secondary maximum contaminant level (MCL) for iron is typically exceeded. Chemical characteristics are variable, depending on geologic factors, adjacent land uses, well extraction, and infiltration.

Excellent quality water is usually obtained from alluvium and alluvial fan deposits. The Wilson Grove Formation generally produces high quality water, although high iron, manganese, sodium, and total dissolved solids have been reported in wells tapping the lower portion of the Wilson Grove Formation.

Many shallow domestic wells and older shallow wells (particularly in the eastern portion of the Santa Rosa Plain) lack adequate sanitary seals. These older wells may serve as a direct conduit for agricultural runoff, potentially contaminated with animal waste, to enter the shallow groundwater and degrade its quality.

Petaluma Valley

The Petaluma Valley includes the North Petaluma and bay flats irrigation areas. The Adobe Road, Lakeville Hillside, Tolay, and Sears Point reservoir sites are considered to be part of the Petaluma Valley groundwater basin[4].

Two significant groundwater quality issues have been reported in the Petaluma Valley groundwater basin. One concern is sea water intrusion. Southeast of the City of Petaluma, wells seemed to be affected by salt water intrusion or brackish water originating in marine deposits (e.g., bay mud deposits). Water quality degradation associated with intrusion involves increased sodium, salinity, total dissolved solids, boron, hardness, iron, and manganese. The California State Department of Water Resources (1982b) reported that the extent of sea water intrusion remained the same or decreased between the early 1960s and early 1980s.

Nitrate contamination is the primary groundwater quality issue in the Petaluma Valley. The presence of nitrate in groundwater is usually the result of infiltration of surface contamination from fertilizers, animal waste from livestock or poultry farms or from septic tank leach fields. The major source of nitrate in the northwest portion of the valley appears to be livestock and poultry farming operations. Nitrate contamination is generally confined to the shallow groundwater zone (California State Department of Water Resources 1986). One well in the vicinity of the Lakeville reservoir site (LN-01), sampled as part of this project, exceeded the drinking water standard (maximum contaminant level or MCL) for nitrate.

Water quality data collected from the monitoring wells indicate that the primary MCL for aluminum is typically exceeded in the vicinity of the Adobe Road and Lakeville reservoir sites. The secondary MCL for iron is exceeded in all of the wells sampled for this project (Parsons Engineering Science, Inc. 1996) in the Petaluma Valley and Tolay watershed. Total dissolved solids (TDS)[5] concentrations at two wells in the Lakeville area (LN-01 and LM-01) exceeded the secondary MCL (500 mg/L). One well at the Lakeville agricultural area (LN-01) exceeded the primary MCL for chloride.

Americano/Stemple Area

A previous groundwater monitoring study involving 27 wells in the Americano/Stemple area indicated that groundwater in the area showed evidence of infiltration of bacteria from surface or near surface sources (CH2M Hill 1990). Coliform bacteria were detected in most of the wells sampled; only two wells were found to be consistently free of bacteria. In general, contamination by microorganisms is limited to shallow aquifers, near the ground surface; typical

---

4 The Tolay Creek watershed is considered to be a subbasin with similar geologic and groundwater conditions as the Petaluma Valley.

5 Total dissolved solids indirectly measures boron, chloride, bicarbonate, sodium, calcium, magnesium, potassium, sulfate and nitrate.

contaminant sources include septic tanks, dairies, feedlots, and poultry ranches. Several wells contained low concentrations of metals (barium, zinc, copper, selenium, and silver) from an unknown source. Metals were detected in concentrations below established drinking water standard maximum contaminant levels (MCLs).

Some wells sampled in the CH2M Hill study were old and not equipped with sanitary seals. Groundwater quality results of that study may not have been representative of the groundwater basin. The groundwater sampling program described above was implemented to provide additional information for this EIR/S and to determine if previously collected data were representative. Results indicate that groundwater in the Americano/Stemple area has been affected by agricultural practices. Nitrate concentrations at two Stemple Creek locations, including the Two Rock well (STRL-01), exceeded the MCL for nitrate. Three of the four monitoring wells installed in the Stemple Creek area (SS-01, STRL-01, and SHL-01) exceeded the MCL (500 mg/L) for TDS[6]. One well at the Two Rock reservoir site (STRL-01) exceeded the MCL for chloride.[6]

The Geysers

The geysers area is underlain by bedrock of the Franciscan Complex. No significant regional aquifers or potential drinking water sources are known in the immediate vicinity of the geysers. Small volumes of unconfined, perched groundwater may be present in surficial landslide and alluvial deposits. In addition, small discontinuous volumes of groundwater may be present within 50 to 1,000 feet of the ground surface occurring in fractured non-reservoir rock in the vicinity of the geysers. The predominant source of both types of groundwater is infiltrating precipitation. Groundwater in the geothermal reservoir (2,000 to 12,000 feet below the ground surface) is hot, of poor quality, and is used to generate electricity at the geysers steamfield.

Reclaimed Water Quality

The following discussion provides a comparison of the quality of groundwater within the Project area to the quality of reclaimed water from the Laguna WWTP. This information has been summarized from project groundwater technical reports (Parsons Engineering Science, Inc. 1996b). The technical reports include data tables that list analytical results for all constituents sampled at each well.

As indicated in the Evaluation Criteria (Table 4.5-3) groundwater quality impacts are evaluated based on public health effects, which are measured by the MCL. The discussion below summarizes the location of wells where constituents were detected above the MCL. The concentration of constituents in wells is compared with the average values measured in the Laguna WWTP reclaimed water.

[6] Reclaimed water from the Laguna Wastewater Treatment Plant does not exceed the MCL for this constituent.

Metals

Water quality data collected from the monitoring wells indicate that metals such as aluminum, magnesium, zinc, and nickel may occur at higher concentrations in groundwater at the reservoir sites than in the reclaimed water. The average levels of metals in reclaimed water are below all the respective maximum contaminant level (MCLs). Metals in excess of the MCLs were detected in wells in Petaluma Valley, Americano and Stemple creeks watershed, and the Lakeville Hillside subbasin, discussed above. Metals tend to bind to soil particles and are not generally soluble in groundwater (USEPA 1981).

Salts and Other Chemical Constituents

The average concentration of total dissolved solids (TDS), fluoride, nitrite, nitrate, and phosphate in the reclaimed water was higher than in groundwater at some locations within the project site. The average concentrations of these constituents, except nitrate, are below the MCLs defined by State and Federal drinking water standards. Only nitrate and nitrite are regulated by primary drinking water standards for protection of public health. Section 4.7, Public Health and Safety provides a detailed discussion of reclaimed water quality in relation to drinking water standards under the topic Human Exposure to Reclaimed Water.

The only water quality constituent in exceedence of the MCL in reclaimed water is nitrate. The MCL for nitrate is 10 milligrams/liter (mg/L). The average detected level of nitrate in reclaimed water from the Laguna Plant is 16.3 mg/L. The average level expected after the completion of upgrades to the Laguna Plant (see Section 3.2, Interim Project) is 14.6 mg/L or lower. The nitrate levels detected in groundwater at the Two Rock subbasin well and Lakeville well were 71.8 mg/L and 12.0 mg/L, respectively. Nitrate is taken up by plants and is readily immobilized in the unsaturated zone. However, once in the groundwater, nitrate is stable and mobile. The only reduction in nitrate levels in groundwater would be through dilution by groundwater that contains little or no nitrate (USEPA 1981).

Coliform

The average detected level of total coliform[7] in reclaimed water has historically been below the detection limit of 2.2 most probable number/100 milliliter (MPN/100 mL). The North Coast Region Water Quality Control Plan (Basin Plan) contains a water quality objective of 1.1 MPN/100 mL for total coliform (North Coast Regional Water Quality Control Board 1995). Total coliform was detected in groundwater from two wells in the Stemple Creek watershed (3.1 and 165.2 MPN/100 mL) and one well in the Lakeville Hillside area (>200.5

[7] Coliform bacteria are indicator organism whose presence is evidence that pollution (associated with fecal contamination from humans or other warm-blooded animals) has occurred. Indicator organisms may be accompanied by pathogens, but do not necessarily cause disease themselves. Indicators have the following general characteristics: they are absent from unpolluted waters, are present in greater numbers than pathogenic organisms, have greater survival time than pathogens, and their detection is more reliable and less time-consuming.

MPN/100mL). Groundwater contamination by coliform is generally the result of input from contaminated surface water (from cattle, poultry, or other animals).

Removal of microorganisms, including bacteria and viruses, occurs in the soil through filtration, adsorption, desiccation, radiation, predation and exposure to other adverse conditions. Coliform does not remain viable in groundwater and soon dies and is filtered out (USEPA 1981). Fecal coliform are normally not found in groundwater after reclaimed water has percolated through five feet of soil (USEPA 1981).

Regulatory Framework

Department of Health Services Guidelines for Use of Reclaimed Water

Criteria for reclaimed water quality are established in Title 22 of the California State Code of Regulations (Title 22, California State Code of Regulations, §60301 et. seq.). Title 22 specifies treatment requirements and establishes water quality standards for reclaimed water (Regulations for Use of Reclaimed Water). The California State Department of Health Services is the agency responsible for development and implementation of the regulations for use of reclaimed water. The Department is currently developing amendments to Title 22 that provide new regulations for the use of reclaimed water and in that effort has developed draft regulations that have not yet been adopted but are used as a guideline for reclaimed water use. The goal of the Department of Health Services draft regulations is to protect public health and at the same time provide alternative methods for disposal of treated wastewater.

Department of Health Services regulations are proposed to regulate the use of reclaimed water for groundwater recharge in spreading basins. The proposed storage reservoirs are intended to operate as storage basins and reclaimed water would not be designated to recharge the groundwater. However, some reclaimed water would inevitably flow from the bottom of the reservoir and may enter the regional groundwater system. Therefore, the Guidelines established for spreading basins have been applied to the proposed reservoir sites.

The draft reclaimed water regulations specify the allowable concentration of total organic carbon (TOC), suspended solids, and biochemical oxygen demand (BOD) in oxidized water. In addition, turbidity of filtered wastewater would be limited to an average of two (2) nephelometric turbidity units (NTUs). The draft regulations also limit the concentration of radioactive material, minerals, inorganic chemicals, nitrogen, and organic chemicals in the reclaimed water. The volume of water that may be used for recharge depends on the depth to groundwater, storage capacity of the receiving aquifer, retention time underground, and horizontal distance from the source of reclaimed water to domestic water supply wells. These draft regulations were used to develop significance criteria for the groundwater impacts of the Project.

Groundwater and Geothermal Resources in Geysers Area

Groundwater resources in the geysers area are regulated by the California State Division of Oil and Gas and Geothermal Resources (Division of Oil & Gas) and the County of Sonoma. Permits for injection are secured through the Division of Oil & Gas with appropriate review from the North Coast Regional Water Quality Control Board. Additional regulation is provided by the U.S. Bureau of Land Management with delegated authority under the Federal Land Policy and Management Act and Geothermal Steam Act. The Bureau of Land Management is also responsible for protection and management of water resources within lands under its jurisdiction.

Groundwater Nondegradation Policy

In 1968, the State Water Resources Control Board adopted Resolution 68-16, "Statement of Policy with Respect to Maintaining High Quality of Waters in California State," establishing a nondegradation policy for the protection of water quality. Under this policy, whenever the existing quality of water exceeds the quality necessary to maintain present and potential beneficial uses of the water, existing water quality must be maintained. This policy pertains to both surface waters and the groundwater of the State.

The Water Quality Control Plan (Basin Plan) for the North Coast Region (North Coast Regional Water Quality Control Board 1994) establishes water quality objectives that are considered to be necessary to protect present and probable future beneficial water uses. As indicated in Section 4.6, Surface Water Quality, this project would require waste discharge requirements approved by the North Coast Regional Water Quality Control Board. The Regional Board would consider potential groundwater impacts of the Project in the context of the adopted Basin Plan and would require that best practicable treatment or discharge control be included in approved Waste Discharge Requirements.

Some degradation of water quality may be considered acceptable if it can be demonstrated that the project would be "consistent with maximum benefit to the people of the State, will not unreasonably affect present and anticipated beneficial uses of such water and will not result in water quality less than that prescribed in the policies" (Resolution No. 68-16). The California State Water Code specifically allows increases of salinity associated with water reclamation projects: "A regional board may not deny issuance of water reclamation requirements to a project which violates only a salinity standard in the basin plan." (Division 7, Chapter 7, Section 13523.5 of the California State Water Code). Therefore, it is possible that Waste Discharge Requirements may be approved that could result in some increase in chemical concentrations in groundwater above background levels. However, in no case may increases in chemical concentrations cause adverse impacts to groundwater resources. Nitrate levels in excess of the maximum contaminant limit for drinking water (10mg/L) would be considered an adverse effect. Waters in which salinity, as measured by total dissolved solids, exceed 3,000 mg/L are considered unsuitable for water

supply (State Water Resources Control Board Resolution No. 88-63, "Sources of Drinking Water).

Groundwater Goals, Objectives, and Policies

Table 4.5-2 identifies goals, objectives, and policies which provide guidance for development in relation to groundwater in the project area. The table also indicates which criteria in this section are responsive to each set of policies.

Table 4.5-2

General Plan Goals, Objectives, and Policies - Groundwater

Adopted Plan Document	Document Section	Document Numeric Reference	Policy	Relevant Evaluation Criteria[1]
Sonoma County General Plan	Resource Conservation Element	Objective RC-3.1 Objective RC-3.3	Preserve and enhance the quality of groundwater resources and preserve watersheds and groundwater recharge areas by avoiding the placement of potential pollution sources in areas with high percolation rates	1,2,4,5
Sonoma County General Plan	Resource Conservation Element	Policy RC-3a	Grading, filling and construction should not substantially reduce or divert any stream flow that would affect groundwater recharge	4,5
Petaluma General Plan	Community Health and Safety Element	Objective (r)	Protect areas that are critical to the maintenance of water quality, including critical groundwater recharge areas	1,2,4,5
Rohnert Park General Plan	Safety Element	Principle 6	Protect groundwater from contamination	1,2,4,5

Source: Harland Bartholomew and Associates, Inc., 1995

1. The evaluation criteria can be found in Table 4.5-3.

EVALUATION CRITERIA WITH POINT OF SIGNIFICANCE

For the purposes of this EIR/EIS groundwater quality impacts are evaluated based on the constituents that are contained in the reclaimed water in concentrations that could cause drinking water to fail to meet state and federal drinking water standards. Drinking water standards were selected because they are the most stringent water quality standards

applicable to groundwater and because drinking water represents the most restrictive beneficial use of Sonoma County groundwater.

The purpose of and rationale for the drinking water standards, potential health effects of water pollution, and identification of constituents of concern, are discussed in Section 4.7, Public Health and Safety. Based on the results of groundwater analysis for this and other projects, the chief constituent of concern for groundwater quality for this Project is nitrate (refer to the Setting Section, Groundwater Quality).

According to Appendix G of the CEQA Guidelines, a project will normally have a significant effect on the environment if it would alter the direction or rate of flow of groundwater; change the quantity of groundwater, either through direct addition or withdrawals or through interception of an aquifer by cuts or excavation; or adversely affect groundwater quality. Groundwater impacts were evaluated for significance based on the criteria listed in Table 4.5-3. The groundwater concepts presented there are discussed further in methodology.

Table 4.5-3

Evaluation Criteria with Points of Significance - Groundwater

Evaluation Criteria	As Measured by	Point of Significance	Justification
1. Will the Project degrade groundwater quality at existing drinking water wells, resulting in a public health hazard?	a. Groundwater from existing domestic drinking water wells exceeds established MCL for Nitrate as defined by State and Federal drinking water standards.	Nitrate levels in groundwater greater than 10 mg/L	State and Federal water quality regulations
	b. Number of documented domestic wells within 20% contribution zone	Greater than 0 wells	The California State Department of Health Services, Office of Drinking Water draft regulations for the use of reclaimed water. (Revised Wastewater Regulations, Title 22, Draft, dated 30 June 1993) Use of these draft regulations for criteria was agreed to by Bruce Burton of the California State Department of Health Services (personal communication, 19 April 1996).

Table 4.5-3

Evaluation Criteria with Points of Significance - Groundwater

Evaluation Criteria	As Measured by	Point of Significance	Justification
	c. Travel time from the reservoir to the closest documented domestic well	Less than 6 months	The California State Department of Health Services, Office of Drinking Water draft regulations for the use of reclaimed water
	d. Distance from the reservoir to the closest documented domestic well	Less than 500 feet	The California State Department of Health Services, Office of Drinking Water draft regulations for the use of reclaimed water
2. Will the Project degrade groundwater quality at future drinking water wells, resulting in a public health hazard?	Number of developable[1] parcels within 20% contribution zone[2]	Greater than 0 parcels	State and Federal water quality regulations. The California State Department of Health Services, Office of Drinking Water draft regulations for the use of reclaimed water.
3. Will the Project cause groundwater mounding or increase groundwater levels that cause surface water discharge in a non-stream environment?	Groundwater levels that are raised to within 6 feet of the surface	Groundwater that is raised to within 6 feet of the surface	Elevated water tables can interfere with the operation of leachfields or can result in surface runoff and flooding.
4. Will the Project lower groundwater levels at existing wells?	Number of documented wells subject to lower groundwater levels	Greater than 0 wells	The reduction of groundwater levels can cause existing wells to cease providing water for their intended uses.
5. Will the Project lower groundwater levels in areas that could have been developed for future water supply?	Number of developable parcels that would be subject to lower groundwater levels	Greater than 0 parcels	The reduction of groundwater levels can eliminate potential future water supply.

Source: Parsons Engineering Science, Inc., 1996

Notes:

1 A developable parcel refers to a currently undeveloped parcel for which a building permit could be issued based on all criteria except the requirement to prove water supply.

2 The 20% contribution zone was chosen as the criterion because it is the largest area of potential groundwater effect and includes the areas that could be within the 500-foot or 6-month limits. A 50% reclaimed water contribution is allowed by the draft regulations only for water treated by removal of organics and does not apply to this Project.

METHODOLOGY

The EIR/EIS impacts analysis is based on a review of relevant hydrogeologic literature and technical reports prepared for impact evaluation for this Project. Potential Project impacts were summarized from the following Technical Reports:

- *Hydrogeology of Storage/Reuse Areas and Evaluation of Potential Impacts to Groundwater* (Parsons Engineering Science, Inc. 1996a)
- *Well Installations and Groundwater Monitoring Results* (Parsons Engineering Science, Inc. 1996b)
- *Baseline Hydrology and Irrigation Drainage Evaluation for West and South County Reclamation Alternatives*, (Questa Engineering Corporation 1995a)

Groundwater Contribution from Reservoirs

Available information was used to construct groundwater contours in the vicinity of each reservoir site. Hydraulic conductivity[8] (K) values were estimated for each reservoir subbasin based on results of geotechnical testing at the reservoir sites. A three-dimensional numerical model was used to verify and refine the K values so that they were consistent with existing groundwater contours. The estimated K values were used to calculate the leakage (measured as a volumetric discharge or the volume of water that flows through a cross sectional area over time) or input into the groundwater system from each reservoir. Comparison of the current groundwater discharge (without the reservoir) and groundwater discharge with the reservoir was used to determine the percent contribution from each reservoir within its groundwater subbasin. Dilution calculations were made to estimate the zone of 20 percent contribution of reclaimed water at each reservoir site.

Some of the factors included in the analysis of the reservoir's contribution to groundwater discharge were the size of the reservoir relative to the reservoir subbasin, the average height of the water level in the reservoir relative to water levels under existing conditions, the distance to the main stream valley, and the assumed hydraulic conductivity.

The estimated areas that could have groundwater contribution from the reservoir in excess of 20 percent (herein referred to as the greater than 20 percent contribution zone) are shown in Figures 4.5-2 to 4.5-10. Concentrations of reclaimed water within the 20 percent contribution zone would range from nearly 100 percent reclaimed water at the base of the reservoir to 20 percent at the downgradient edge of the zone. Outside the boundary of the zone, concentrations would be less than 20 percent. The zone describes contributions at equilibrium, which may take several years to achieve. The concentration of reclaimed water outside the zone is not predicted to exceed 20 percent. The 20 percent reclaimed water concentration was developed by the Department of Health Services as an acceptable level for wells adjacent to reclaimed water recharge areas.

The quality of reclaimed water that may seep from reservoirs is not necessarily the same as that measured in reclaimed water at the treatment plant, because biological activity in a

[8] A coefficient describing the rate at which fluid can move through a permeable medium.

thermally stratified storage reservoir affects reclaimed water quality. In particular, dissolved oxygen can be depleted, nitrate can be converted to ammonia, and sulfur compounds can be converted to hydrogen sulfide in the bottom layer of a thermally stratified reservoir. Thermal stratification can exist from mid-spring through summer. For purposes of the surface water quality impacts analysis, maximum ammonia and hydrogen sulfide formation was assumed because ammonia is a greater concern for aquatic biota than nitrate. The groundwater impacts evaluation assumed that nitrate levels in reclaimed water would not be reduced by conversion to ammonia, because drinking water standards for nitrate are the primary concern for groundwater.

Groundwater Level Increase

To determine the potential impact of the reservoirs on groundwater levels, WinFlow, a two-dimensional analytical model was used. The gradient in the vicinity of the reservoir under existing conditions was used to establish baseline conditions. The same hydraulic parameters (i.e., hydraulic conductivity, storativity[9], porosity and aquifer thickness) that were estimated previously were used in this modeling.

During the installation of monitoring wells in the downgradient vicinity of the reservoir sites, confined groundwater conditions were encountered in geologic units underlying alluvial deposits. It is likely that leakage from the reservoir sites would contribute to an increase in pore pressures in the confined unit, and that groundwater level increases would be somewhat less than projected by the model.

Well Locations

Three sources of information were used to locate wells. California State Department of Water Resources well logs were reviewed. In some areas, particularly the more rural areas where access was available, wells were located based on visual evidence (i.e., water tower) or anecdotal information from residents. A third source of well locations was the groundwater monitoring program conducted in 1989 and 1990 (CH2M Hill 1990). This third source of information was only available for wells in the Stemple Creek and Americano Creek watersheds. Some of these wells may represent duplicates of other wells, particularly since wells documented on California State Department of Water Resources well logs could not always be precisely located. Well locations in the vicinity of the reservoir are shown in Figures 4.5-2 to 4.5-10.

The use of water from rural wells could not always be determined. It has been assumed for the purposes of this analysis that all of the wells are used for domestic drinking water, although some of these wells are used only for irrigation. It is likely that some of the documented wells are no longer in service and that other wells are in use within the reservoir subbasins that have not been documented in this study.

9 Storativity is the volume of water that a permeable unit releases from or takes into storage per unit surface area of the aquifer per unit change in head.

Data from Groundwater Monitoring Wells

Groundwater monitoring wells were installed as part of the groundwater evaluation for this Project to provide information about water levels and groundwater quality in the vicinity of reservoir sites and irrigation areas (Parsons Engineering Science, Inc. 1996b). Up to two wells were installed in each subbasin with a maximum of four wells in a single watershed. Groundwater from these wells was analyzed during a single sampling event in the Fall of 1995.

Analysis of the currently available data and application of computer modeling permits a general evaluation of potential impacts at each of the reservoir subbasins. However, analytical results for the Project groundwater impact evaluation cannot be applied to the entire groundwater subbasin and a well-by-well impact analysis is not possible. For these reasons it is recommended that a groundwater monitoring program be initiated upon selection of a Project reservoir site (refer to the Mitigation Monitoring Program). Pre-construction groundwater monitoring data would provide detailed information and would permit meaningful comparison of year-round, subbasin-wide baseline data with post-reservoir quarterly monitoring data.

ENVIRONMENTAL CONSEQUENCES (IMPACTS) AND MITIGATION MEASURES

No Action (No Project) Alternative

Impact: **5.1.1-5. Will the No Action Alternative impact groundwater based on evaluation criteria 1 through 5?**

Analysis: *No Impact; Alternative 1.*

The No Action Alternative will not result in new facilities or operations that could provide inputs to groundwater.

Mitigation: No mitigation is needed.

Headworks Expansion Component

Impact: **5.2.1-5. Will the headworks expansion component impact groundwater based on evaluation criteria 1 through 5?**

Analysis: *No Impact; All Alternatives.*

The headworks expansion component will not involve construction of facilities that could affect groundwater.

Alternative 1 does not have a headworks expansion component.

Mitigation: No mitigation is needed.

Urban Irrigation Component

Table 4.5-4

Groundwater Impacts by Component - Urban Irrigation

Evaluation Criteria	Point of Significance	Impact	Type of Impact	Level of Significance
5.3.1. Will the urban irrigation component degrade groundwater quality at existing drinking water wells, resulting in a public health hazard?	a. Nitrate levels in groundwater greater than 10 mg/L b. Greater than 0 wells in 20 percent contribution zone c. Less than 6 months travel time from reservoir to well d. Less than 500 feet from reservoir to well	<10 mg/L Points of significance not applicable for irrigation	O&M	❍
5.3.2. Will the urban irrigation component degrade groundwater quality at future drinking water wells, resulting in a public health hazard?	Greater than 0 parcels	0 parcels	O&M	==
5.3.3. Will the urban irrigation component cause groundwater mounding or increase groundwater levels that cause surface water discharge in a non-stream environment?	Groundwater that is raised to within 6 feet of the surface	None within 6 feet of the ground surface	O&M	==
5.3.4. Will the urban irrigation component lower groundwater levels at existing wells?	Greater than 0 wells	0	O&M	==
5.3.5. Will the urban irrigation component lower groundwater levels in areas that could have been developed for future water supply?	Greater than 0 parcels	0	O&M	==

Source: Parsons Engineering Science, Inc., 1996

Notes: 1. Type of Impact:
O&M Operation and Maintenance

2. Level of Significance:
== No impact
❍ Less than significant impact; no mitigation proposed

Impact: **5.3.1. Will the urban irrigation component degrade groundwater quality at existing drinking water wells, resulting in a public health hazard?**

Analysis: *Less than Significant; Alternatives 2 and 3.*

Nitrate is the only constituent of concern because nitrate is present in reclaimed water at levels that exceed the MCL for drinking water. The EPA Process Design Manual for Land Treatment of Municipal Water (USEPA 1981) was used to assess urban irrigation impacts on water quality (Questa Engineering Corporation 1995b). Nitrate levels in reclaimed water are below the nitrate requirements of crops. Therefore, nitrate in reclaimed water will be taken up by the plants (primarily grass) and little, if any will migrate beyond the root zone. Available nitrate will be used by the plants and will not affect groundwater quality in the irrigation areas. Only minor increases in nitrate levels in groundwater will occur.

No Impact; Alternatives 1, 4, and 5.

The alternatives do not have an urban irrigation component.

Mitigation: No mitigation is proposed.

Impact: **5.3.2-5. Will the urban irrigation component impact groundwater based on evaluation criteria 2 through 5?**

Analysis: *No Impact; All Alternatives.*

Areas that are currently irrigated with groundwater could experience an increase in groundwater levels as irrigation pumping declines and groundwater levels return to pre-pumping levels. Groundwater modeling indicates that urban irrigation will not result in mounding.

Groundwater levels will not decline.

Alternatives 1, 4, and 5 do not have an urban irrigation component.

Mitigation: No mitigation is needed.

Pipeline Component

Table 4.5-5

Groundwater Impacts by Component - Pipeline

Evaluation Criteria	Point of Significance	Impact	Type of Impact	Level of Significance
5.4.1. Will the pipeline component degrade groundwater quality at existing drinking water wells, resulting in a public health hazard?	Nitrate levels in groundwater greater than 10 mg/L	<10mg/L	C, O&M	==
5.4.2. Will the pipeline component degrade groundwater quality at future drinking water wells, resulting in a public health hazard?	Greater than 0 parcels	0	C, O&M	==
5.4.3. Will the pipeline component cause groundwater mounding or increase groundwater levels that cause surface water discharge in a non-stream environment?	Groundwater that is raised to within 6 feet of the surface	None during construction; pipeline failure may have temporary mounding, but not within 6 feet of surface.	C, O&M	❍
5.4.4. Will the pipeline component lower groundwater levels at existing wells?	Greater than 0 wells	0	O&M	==
5.4.5. Will the pipeline component lower groundwater levels in areas that could have been developed for future water supply?	Greater than 0 parcels	0	O&M	==

Source: Parsons Engineering Science, Inc., 1996.

Notes:
1. Type of Impact:
C Construction
O&M Operation and Maintenance

2. Level of Significance:
== No impact
❍ Less than significant impact; no mitigation proposed

Impact: 5.4.1, 2, 4, and 5. Will the pipeline component impact groundwater based on evaluation criteria 1, 2, 4, and 5?

Analysis: *No Impact; All Alternatives.*

Construction of transmission pipelines will involve trenching along roadways where shallow groundwater could occasionally be encountered. Trenching 6 to 14 feet deep will not significantly affect groundwater levels. Construction activities could locally increase turbidity in groundwater, however, these effects would be temporary and localized.

Groundwater will not be depleted in event of pipeline rupture.

Alternatives 1 and 5B do not have a pipeline component.

Mitigation: No mitigation is needed.

Impact: 5.4.3. Will the pipeline component cause groundwater mounding or increase groundwater levels that cause surface water discharge in a non-stream environment?

Analysis: *Less than Significant; Alternatives 2, 3, 4, and 5A.*

Construction of transmission pipelines will involve trenching along roadways where shallow groundwater could occasionally be encountered. Neither construction nor operation of pipelines will cause mounding, however, pipeline failure could result in the rapid release of water. Water released by this mechanism will flow overland or in channels as surface water. Because this event will be a rapid, one time release, little or no infiltration to groundwater is expected. Therefore, groundwater mounding impacts will not occur.

No Impact; Alternatives 1 and 5B.

These alternatives do not have a pipeline component.

Mitigation: No mitigation is needed.

Storage Reservoir Component

Table 4.5-6

Groundwater Impacts by Component - Storage Reservoir, Criterion 1

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
1. Will the storage reservoir component degrade groundwater quality at existing wells, resulting in public health hazards?				
a. Projected groundwater quality at existing drinking water wells.	Nitrate levels greater than 10 mg/L	16.3 mg/L	O&M	⊙
b. Number of documented domestic wells within 20 percent contribution zone	Greater than 0 wells		O&M	
• Tolay Extended		0		--
• Adobe Road		20		⊙
• Tolay Confined		0		--
• Lakeville Hillside		4		⊙

Table 4.5-6

Groundwater Impacts by Component - Storage Reservoir, Criterion 1

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
• Sears Point		0		--
• Two Rock		25		⊙
• Bloomfield		12		⊙
• Carroll Road		14		⊙
• Valley Ford		4		⊙
• Huntley		5		⊙
c. Travel time from the reservoir to the closest documented domestic well	Less than 6 months		O&M	
• Tolay Extended		166 years		==
• Adobe Road		67 years		==
• Tolay Confined		166 years		==
• Lakeville Hillside		67 years		==
• Sears Point		133 years		==
• Two Rock		100 years		==
• Bloomfield		133 years		==
• Carroll Road		5 years		==
• Valley Ford		67 years		==
• Huntley		33 years		==
d. Distance from the reservoir to the closest documented domestic well	Less than 500 feet		O&M	
• Tolay Extended		5,000 feet		==
• Adobe Road		2,000 feet		==
• Tolay Confined		5,000 feet		==
• Lakeville Hillside		2,000 feet		==
• Sears Point		4,000 feet		==
• Two Rock		3,000 feet		==
• Bloomfield		4,000 feet		==
• Carroll Road		250 feet		⊙
• Valley Ford		2,000 feet		==
• Huntley		1,000 feet		==

Source: Parsons Engineering Science, Inc., 1996

Notes: 1. Type of Impact:
O&M Operation and Maintenance

2. Level of Significance:
== No impact
⊙ Significant impact before mitigation; less than significant impact after mitigation

Impact: **5.5.1A. Will the storage reservoir component degrade groundwater quality at existing wells, resulting in public health hazards, as measured by projected nitrate levels?**

Analysis: *Significant; Alternatives 2 and 3.*

Reclaimed water with elevated nitrate concentrations (possibly in excess of MCL) could enter the regional groundwater system and result in increased nitrate levels. The reservoir contribution of nitrate will diminish with distance from the dam. Refer to Figures 4.5-2 to 4.5-10 at the end of this impact discussion for the area below each reservoir where 20 percent or greater contribution to groundwater could occur.

The estimated Project contribution of nitrate beyond the 20 percent or greater contribution zone will be 3.3 mg/L or less. This will not cause exceedences of the MCL in areas where the existing levels of nitrate in groundwater are low. However, in areas where existing levels of nitrate are close to the MCL, the resulting concentration could exceed the MCL; this could occur both within and at the margins of the 20 percent contribution zone. In areas where nitrate concentrations in the groundwater are in excess of the MCL, the reservoir contribution could make the exceedence worse. Existing nitrate levels at some monitoring wells in the vicinity of the Lakeville and Two Rock sites showed concentrations that exceed the MCL.

No Impact; Alternatives 1, 4, and 5.

These alternatives do not have a storage reservoir component.

Mitigation: *Alternatives 2 and 3.*

2.3-12. Provide replacement water supply for affected wells.

Alternatives 1, 4, and 5. No mitigation is needed.

After Mitigation: *Less than Significant after Mitigation; Alternatives 2 and 3.*

With provision of an alternative water supply, where needed, this impact will no longer be significant.

Impact: **5.5.1B, C, D. Will the storage reservoir component degrade groundwater quality at existing wells resulting in public health hazards, as measured by the number of documented domestic wells within 20 percent contribution zone, travel time from the reservoir to the closest domestic well; and distance from the reservoir to the closest documented domestic well?**

Analysis: *Significant; Alternatives 2B, 2D (Lakeville Hillside reservoir), and 3.*

Adobe Road

The Adobe Road reservoir site is entirely underlain by the Petaluma Formation. Wells downgradient of this reservoir could be affected by the reservoir if they were screened[10] in the Petaluma Formation. Groundwater inputs from the Adobe Road reservoir could affect a large area of the Petaluma Valley. The greater than 20 percent zone extends from the reservoir downgradient to the Petaluma River (Figure 4.5-3).

Most of the wells east of Adobe Road are at least partially screened in the Petaluma Formation and could be impacted by the reservoir. The wells west of Adobe Road are screened in the alluvial deposits and will probably not be impacted by the reservoir.

Twenty wells have been identified in the Adobe Road subbasin. Four of these wells are located on the upgradient boundary of the reservoir and would not be affected by the reservoir. The area to the west of Adobe Road is served by municipal water from the City of Petaluma (1995). The remaining six wells are located just east of Adobe Road. Although California State Department of Water Resources well logs indicate that at least one former City well is located in the groundwater impact area, the City no longer uses groundwater as a municipal supply.

The nearest documented well will not receive a contribution of reclaimed water for about 67 years.

Lakeville Hillside

The Lakeville Hillside reservoir is entirely underlain by the Petaluma Formation. Wells downgradient of this reservoir could be affected if they are screened in the Petaluma Formation.

Four wells have been identified in the Lakeville Hillside subbasin. All of the wells are located downgradient and within the greater than 20 percent contribution zone from the reservoir (Figure 4.5-5). At least three of these wells are screened in the Petaluma Formation and could receive reclaimed water inputs from the proposed reservoir. The screened interval of the fourth well is unknown.

The nearest documented well will not receive a contribution of reclaimed water for about 67 years.

Sears Point

The Sears Point reservoir is part of Alternative 2D, but has no impact regarding these criteria. Refer to the "No Impact" discussion below.

Two Rock

Two Rock reservoir site is underlain by the Franciscan Complex. It is anticipated that the leakage from the reservoir will be confined to that

10 Screened interval is the portion of the well casing that is perforated and therefore contributes water to the well. A well is described as partially screened in a particular formation if the casing is perforated in more than one geologic unit and can draw water from both. For example, a well with its casing perforated in both the Petaluma Formation and alluvial deposits is partially screened in the Petaluma Formation.

hydrogeologic unit and will not affect overlying units of Wilson Grove Formation and alluvial deposits. Based on a review of the California State Department of Water Resources well logs, some of the downgradient wells at the Two Rock reservoir site are screened exclusively in the alluvial deposits, but several appear to be screened in both alluvial deposits and the Franciscan Complex. The reservoir could contribute to some flow in the wells screened at least partially in the Franciscan Complex.

Twenty-six wells have been identified in the Two Rock subbasin (Figure 4.5-6). One of these wells is located in a tributary valley where groundwater will not be affected by the reservoir. The remaining wells are scattered in downgradient locations and are all located within the greater than 20 percent contribution zone for the proposed Two Rock reservoir.

The nearest documented well will not receive a contribution of reclaimed water for about 130 years.

Bloomfield

The Bloomfield reservoir site is underlain by Wilson Grove Formation and groundwater contribution from the reservoir will be confined to that formation. Most of the wells downgradient of the reservoir are at least partially screened in the Wilson Grove Formation and could be affected by reclaimed water inputs from the reservoir.

The downgradient extent of the greater than 20 percent contribution zone from the Bloomfield reservoir is estimated to be at the downstream boundary of the Carroll Road subbasin. Three wells have been identified in the Bloomfield subbasin, all are located near the downstream extent of the subbasin and within the reservoir's greater than 20 percent contribution zone. A cluster of domestic wells in the main valley is located just upgradient from the Bloomfield reservoir subbasin, outside of the influence of the reservoir. It is estimated that the nine wells located in the main valley in the vicinity of the Carroll Road reservoir site could also be within the greater than 20 percent contribution zone from the Bloomfield reservoir (Figure 4.5-7).

The nearest documented well will not receive a contribution of reclaimed water for at least 130 years.

Carroll Road

The Carroll Road reservoir site is underlain by Wilson Grove Formation and groundwater contribution from the reservoir will be confined to that formation. Most of the wells downgradient of the reservoir are at least partially screened in the Wilson Grove Formation and could be affected by reclaimed water inputs from the reservoir.

Seventeen wells have been located in the Carroll Road North subbasin. Three of these wells are located in the footprint of the proposed reservoir and will be removed during reservoir construction. The remaining wells

are located downgradient of the reservoir and are within the greater than 20 percent contribution zone from the reservoir (Figure 4.5-8).

The nearest documented well, which is located approximately 250 feet downgradient of the dam could receive a contribution of reclaimed water within about 8 years of reservoir installation.

Valley Ford

The Valley Ford reservoir site is underlain by Wilson Grove Formation and groundwater contribution from the reservoir will be confined to that formation. Most of the wells downgradient of the reservoir are at least partially screened in the Wilson Grove Formation and could be affected by reclaimed water inputs from the reservoir.

Review of available information indicates that there are five wells located in the Valley Ford reservoir subbasin. One of these wells is located in the footprint of the proposed reservoir and will be removed during reservoir construction. The remaining wells are located at the downgradient reaches of the subbasin and are near the edge of the greater than 20 percent contribution zone.

The nearest documented well will not receive a contribution of reclaimed water for about 67 years.

Huntley

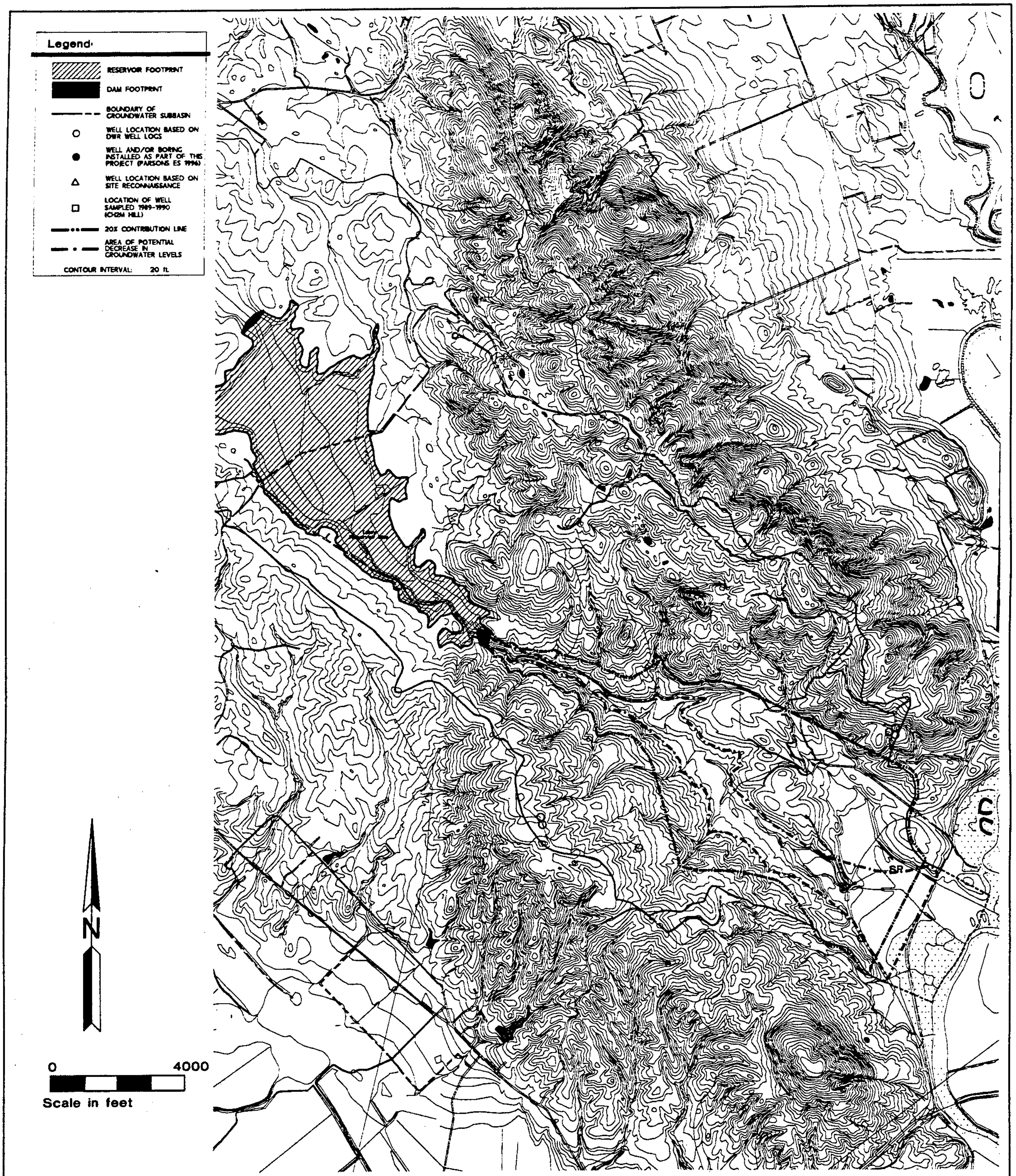
The Huntley reservoir site is underlain by Franciscan Complex. It is anticipated that the leakage from the reservoir will be confined to that hydrogeologic unit and would not affect overlying units of Wilson Grove Formation and alluvial deposits. Information regarding well screening was not available. However, if downgradient wells were screened in the Franciscan Complex they could be affected by the reservoir.

Seven wells have been identified in the Huntley subbasin. One of these wells is located in the footprint of the reservoir and will be removed during reservoir construction. Five of the wells are located downgradient and within the greater than 20 percent contribution zone from the reservoir. One well was located on a topographic high on the upgradient boundary of the subbasin and groundwater will not be affected by reclaimed water impacts from the proposed reservoir (Figure 4.5-10).

The nearest documented well will not receive a contribution of reclaimed water for about 33 years.

No Impact; Alternatives 1, 2A, 2C, 4, and 5.

Both proposed configurations of the Tolay reservoir and the Sears Point reservoir are primarily underlain by the Petaluma Formation. It is unlikely that leakage from the reservoir will contribute substantial groundwater to other geologic units in the Tolay watershed (i.e., Franciscan Complex, Sonoma Volcanics, and the alluvial deposits).

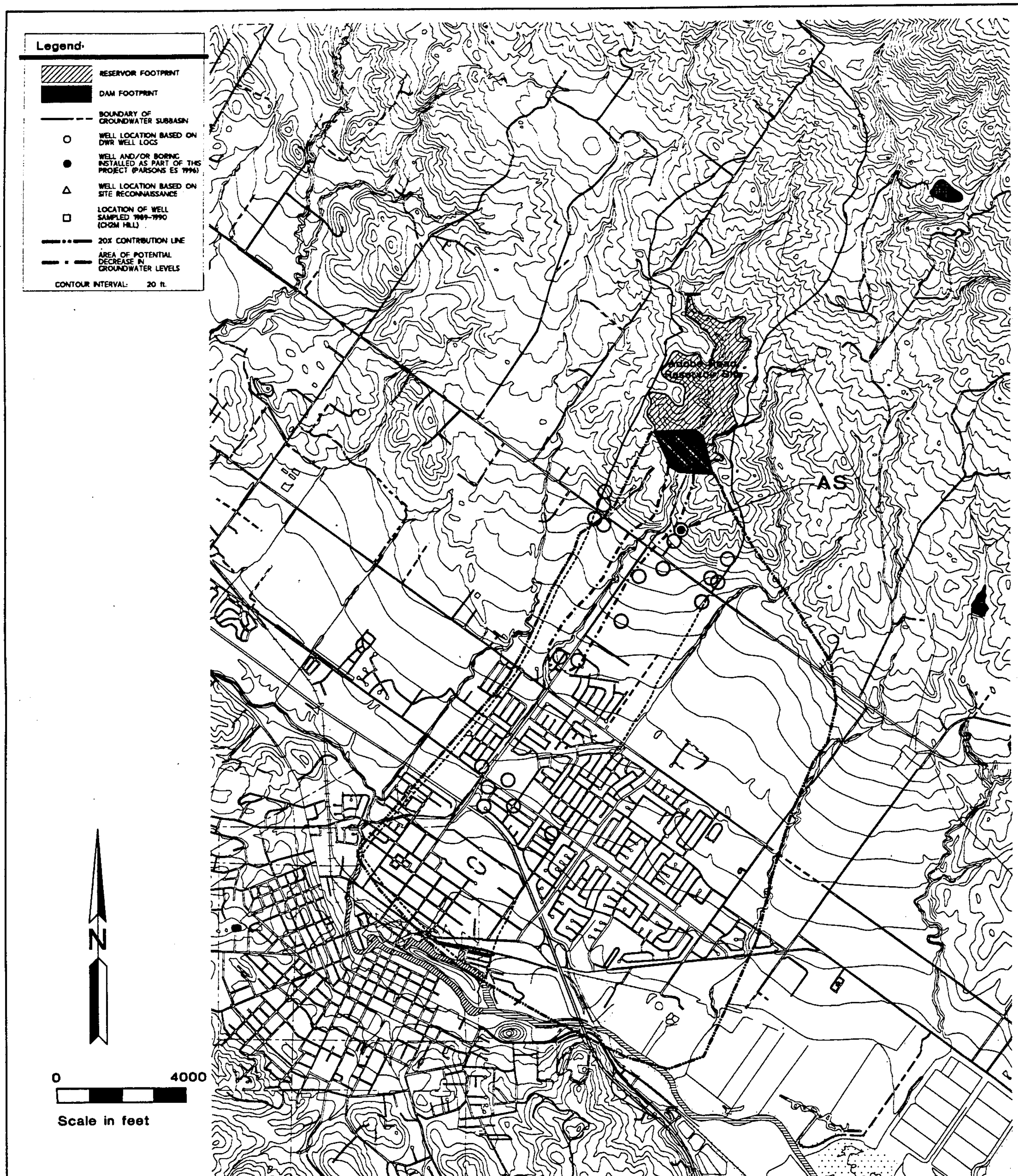


HARLAND BARTHOLOMEW and ASSOCIATES, INC.
PARSONS ENGINEERING SCIENCE, INC.
UNITS OF PARSONS INFRASTRUCTURE and TECHNOLOGY GROUP INC.
PARSONS

Santa Rosa
Subregional Long-Term Wastewater Project

AREA OF POTENTIAL DECREASE IN GROUNDWATER LEVELS TOLAY RESERVOIR SITE

Figure 4.5-2

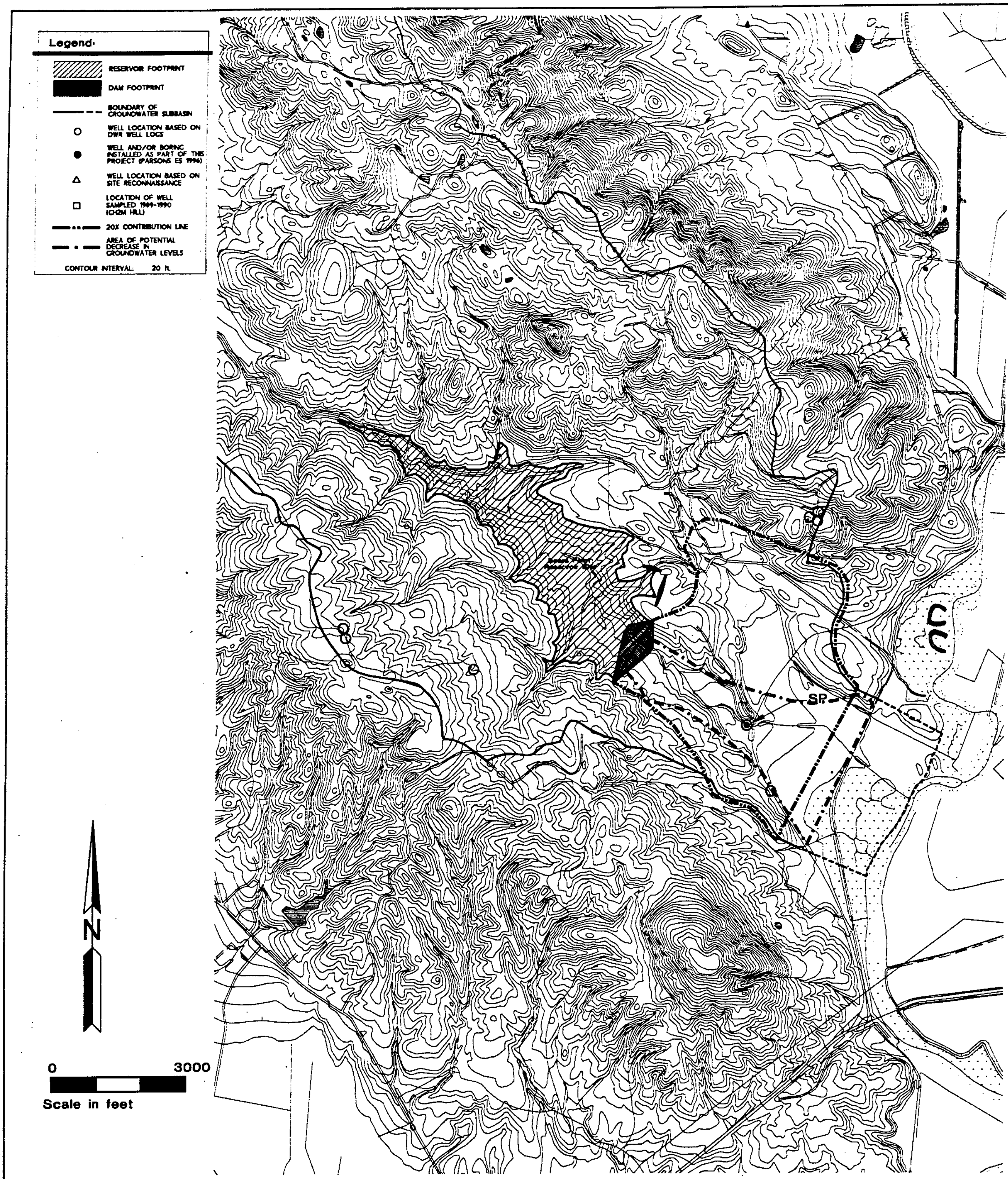


HARLAND BARTHOLOMEW and ASSOCIATES, INC.
PARSONS ENGINEERING SCIENCE, INC.
UNITS OF PARSONS INFRASTRUCTURE and TECHNOLOGY GROUP INC.
PARSONS

Santa Rosa
Subregional Long-Term
Wastewater Project

AREA OF POTENTIAL DECREASE IN GROUNDWATER LEVELS ADOBE ROAD RESERVOIR SITE

Figure 4.5-3

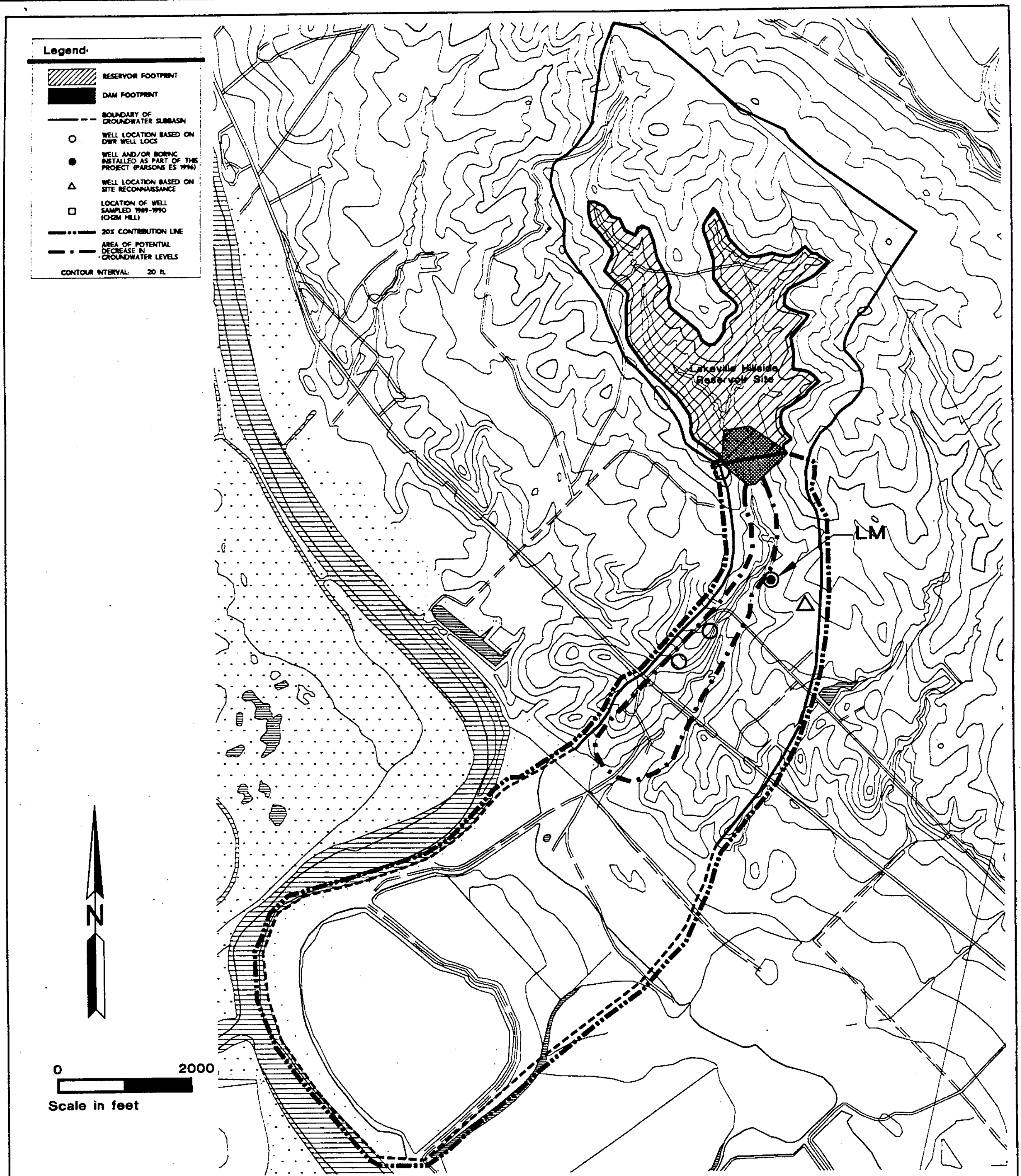


HARLAND BARTHOLOMEW and ASSOCIATES, INC.
PARSONS ENGINEERING SCIENCE, INC.
UNITS OF PARSONS INFRASTRUCTURE and TECHNOLOGY GROUP INC.
PARSONS

Santa Rosa
Subregional Long-Term Wastewater Project

AREA OF POTENTIAL DECREASE IN GROUNDWATER LEVELS SEARS POINT RESERVOIR SITE

Figure 4.5-4

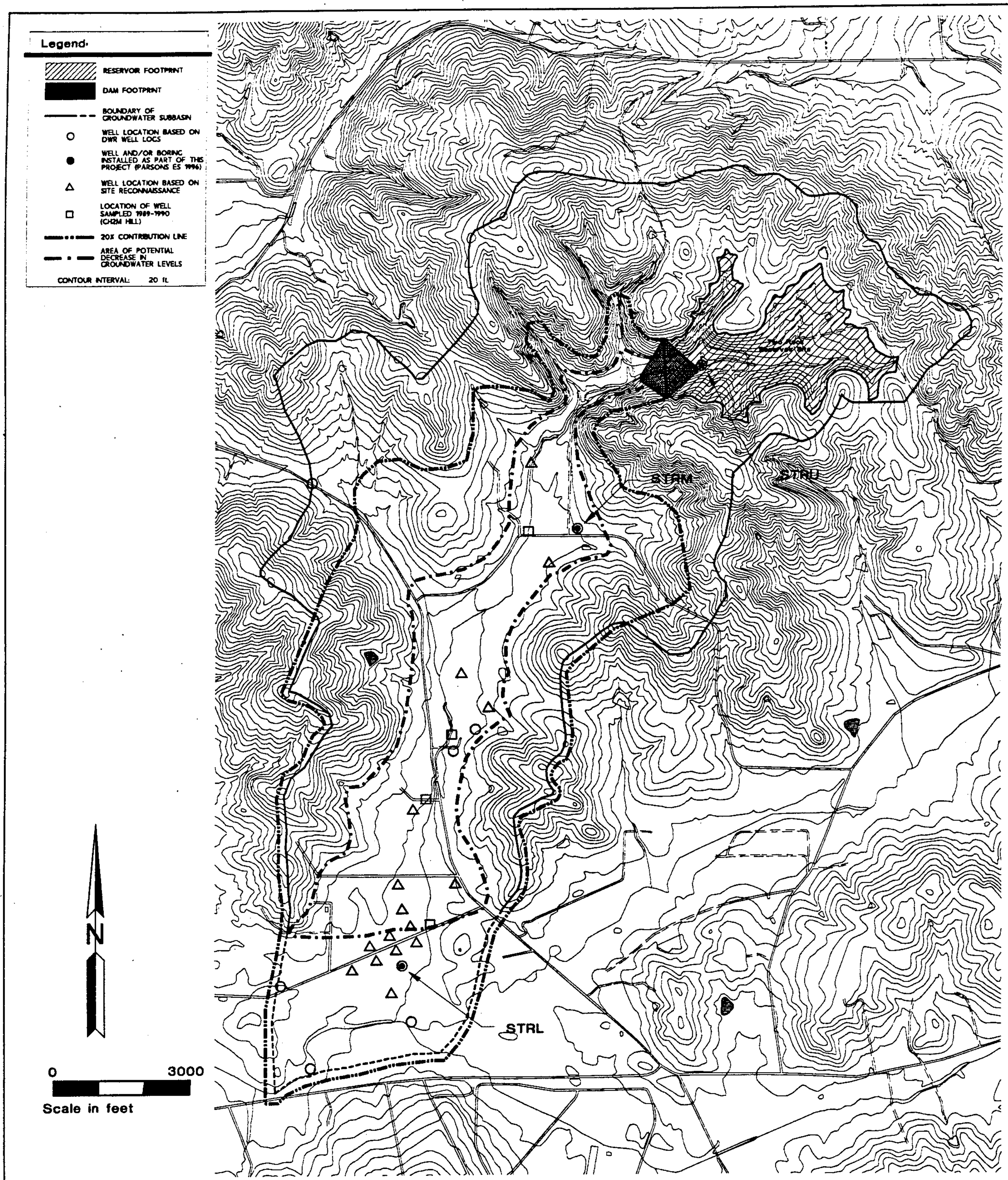


HARLAND BARTHOLOMEW and ASSOCIATES, INC.
PARSONS ENGINEERING SCIENCE, INC.
UNITS OF PARSONS INFRASTRUCTURE and TECHNOLOGY GROUP INC.
PARSONS

Santa Rosa
Subregional Long-Term Wastewater Project

AREA OF POTENTIAL DECREASE IN GROUNDWATER LEVELS LAKEVILLE HILLSIDE RESERVOIR SITE

Figure 4.5-5

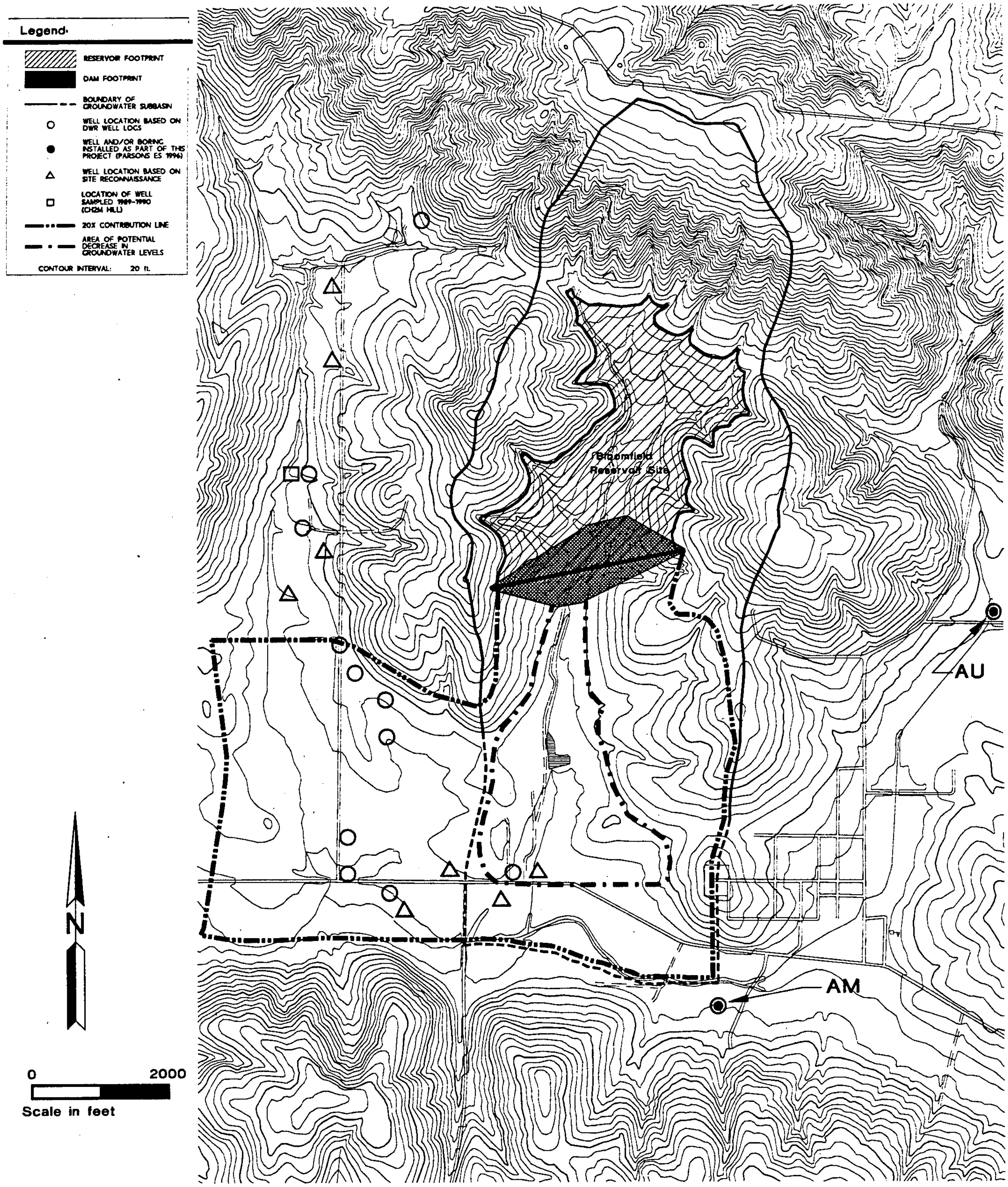


HARLAND BARTHOLOMEW and ASSOCIATES, INC.
PARSONS ENGINEERING SCIENCE, INC.
UNITS OF PARSONS INFRASTRUCTURE and TECHNOLOGY GROUP INC.
PARSONS

Santa Rosa
Subregional Long-Term Wastewater Project

AREA OF POTENTIAL DECREASE IN GROUNDWATER LEVELS TWO ROCK RESERVOIR SITE

Figure 4.5-6

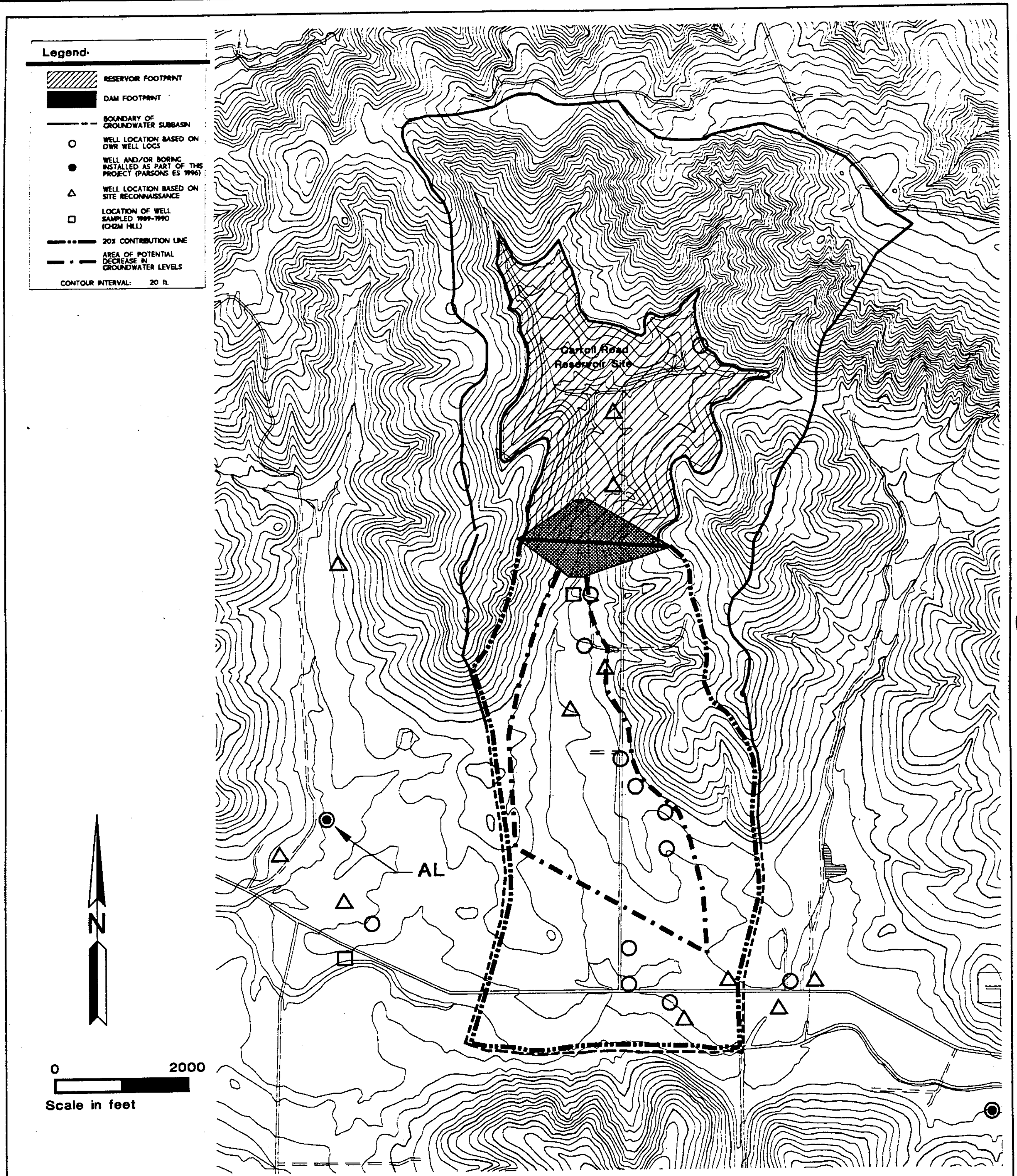


HARLAND BARTHOLOMEW and ASSOCIATES, INC.
PARSONS ENGINEERING SCIENCE, INC.
UNITS OF PARSONS INFRASTRUCTURE and TECHNOLOGY GROUP INC.
PARSONS

Santa Rosa
Subregional Long-Term Wastewater Project

AREA OF POTENTIAL DECREASE IN GROUNDWATER LEVELS BLOOMFIELD RESERVOIR SITE

Figure 4.5-7

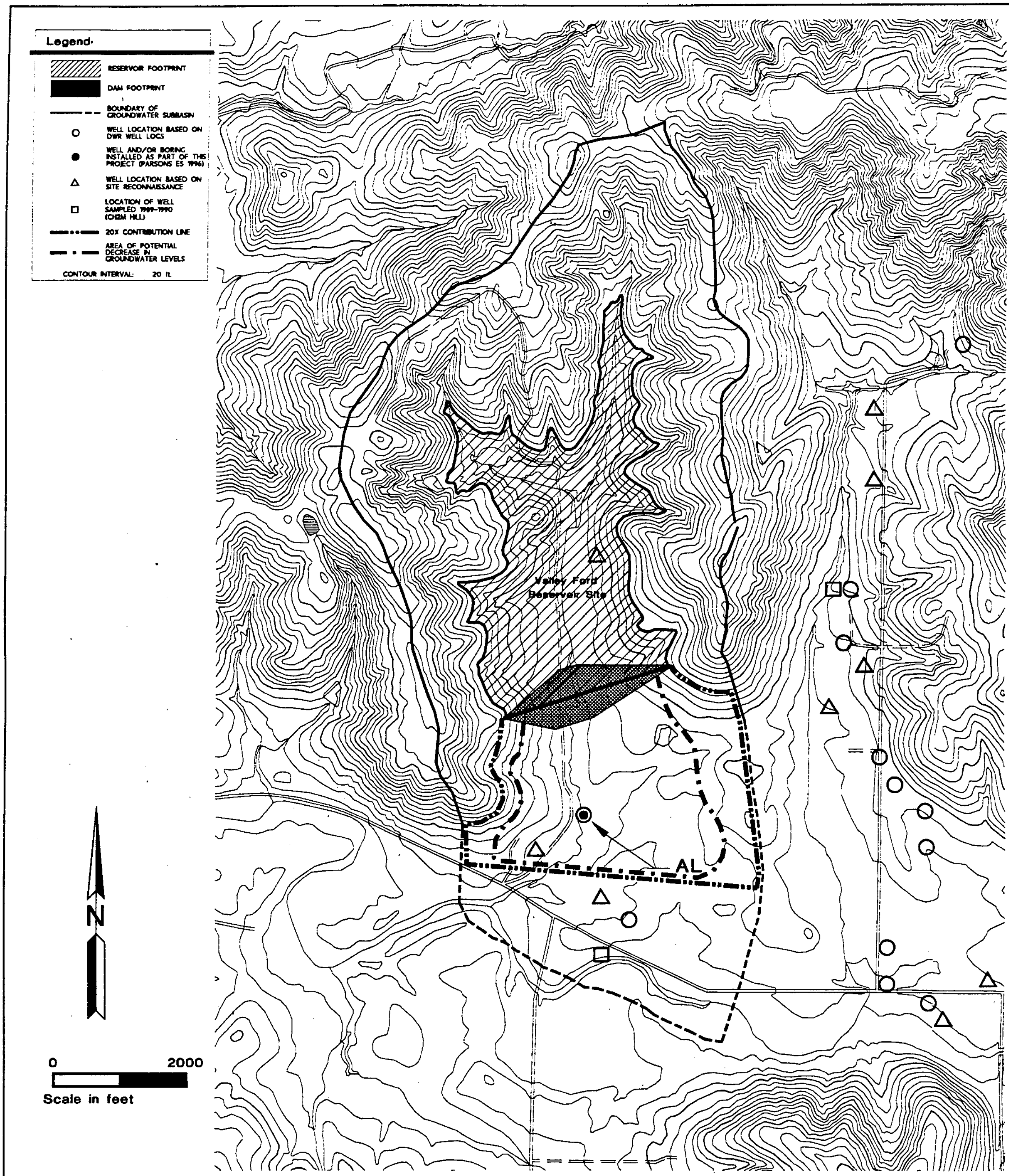


HARLAND BARTHOLOMEW and ASSOCIATES, INC.
PARSONS ENGINEERING SCIENCE, INC.
UNITS OF PARSONS INFRASTRUCTURE and TECHNOLOGY GROUP INC.
PARSONS

Santa Rosa
Subregional Long-Term Wastewater Project

AREA OF POTENTIAL DECREASE IN GROUNDWATER LEVELS CARROLL ROAD RESERVOIR SITE

Figure 4.5-8

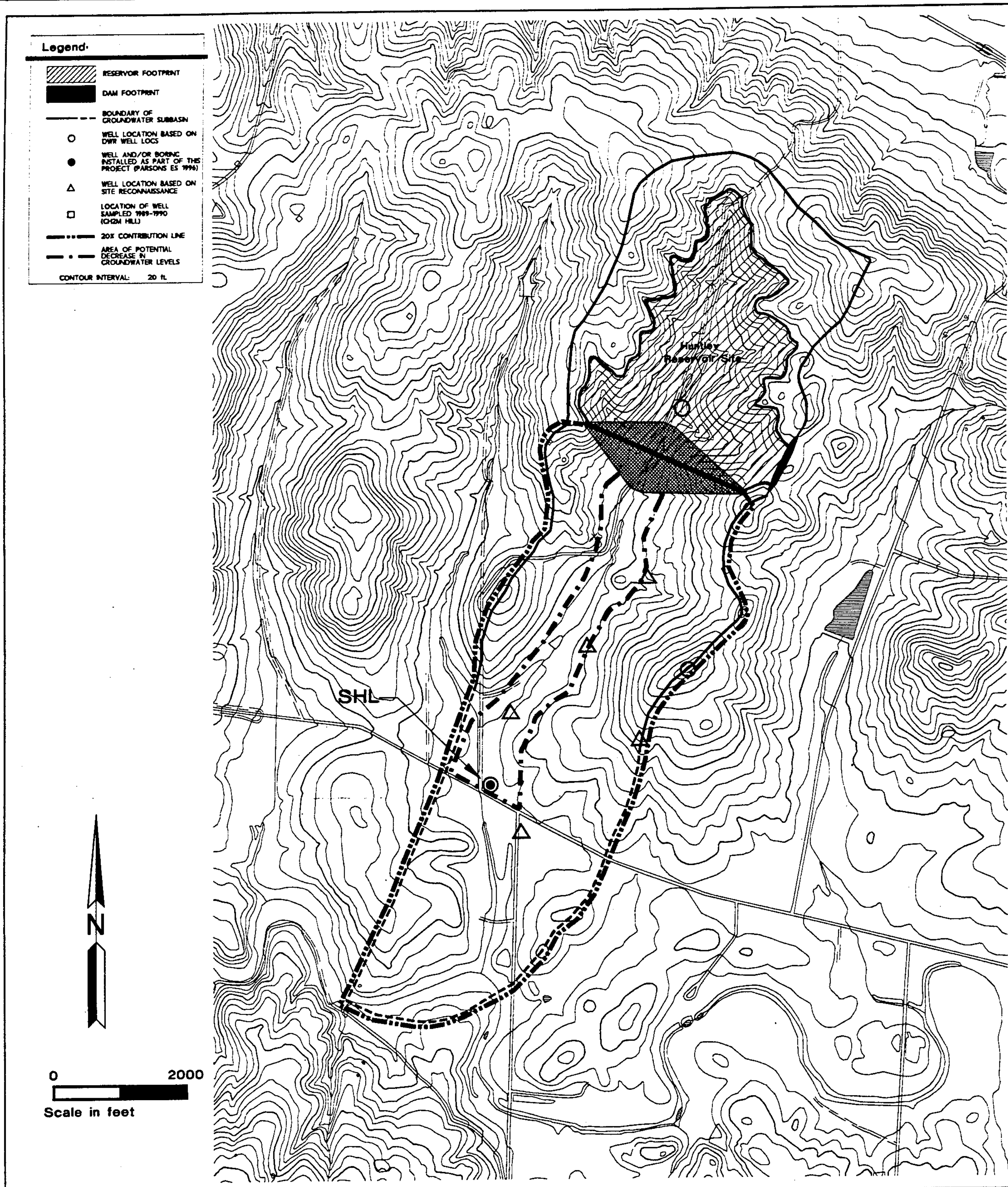


HARLAND BARTHOLOMEW and ASSOCIATES, INC.
PARSONS ENGINEERING SCIENCE, INC.
UNITS OF PARSONS INFRASTRUCTURE and TECHNOLOGY GROUP INC.
PARSONS

Santa Rosa
Subregional Long-Term Wastewater Project

AREA OF POTENTIAL DECREASE IN GROUNDWATER LEVELS VALLEY FORD RESERVOIR SITE

Figure 4.5-9



HARLAND BARTHOLOMEW and ASSOCIATES, INC.
PARSONS ENGINEERING SCIENCE, INC.
UNITS OF PARSONS INFRASTRUCTURE and TECHNOLOGY GROUP INC.
PARSONS

Santa Rosa
Subregional Long-Term Wastewater Project

AREA OF POTENTIAL DECREASE IN GROUNDWATER LEVELS HUNTLEY RESERVOIR SITE

Figure 4.5-10

There are seven wells identified in the Tolay Creek watershed. Six of these wells are located upgradient of the reservoir on steep slopes near the boundary of the watershed and are screened in the Franciscan Complex or in Sonoma Volcanics. These wells will not be affected by the reservoir. One well located downgradient of the reservoir sites is outside the 20 percent contribution zone and will receive significantly less than 20 percent contribution from any of the reservoirs proposed for this watershed. This well is screened in the alluvial deposits. It is possible that other wells, not documented in this report, are present within the subbasin that may be affected by the Project. However, based on information obtained from site reconnaissance and California State Department of Water Resources well logs it appears that no existing wells will be affected by these three reservoir configurations (Figures 4.5-2 and 4.5-4).

Maximum average groundwater flow travel time at all reservoir sites was estimated at 3 feet per year, but a conservative groundwater flow rate assumption of 30 feet per year was used. The documented well nearest the Tolay and Sears Point reservoir sites will not receive a contribution of reclaimed water for at least 130 years.

Alternatives 1, 4, and 5 do not have a storage reservoir component.

Mitigation: *Alternatives 2B, 2D, and 3.*

2.3.12. Provide replacement water supply for affected wells.

Alternatives 1, 2A, 2C, 4, and 5. No mitigation is needed.

After Mitigation: *Less than Significant after Mitigation; Alternatives 2B, 2D, and 3.*

With provision of an alternate water supply, where needed, this impact will no longer be significant. This mitigation measure has secondary growth-inducing impacts discussed in Chapter 5.3.

Table 4.5-7

Groundwater Impacts by Component - Storage Reservoirs, Criteria 2 to Criteria 5

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
5.5.2. Will the storage reservoir component degrade groundwater quality at future drinking water wells, resulting in a public health hazard?	Greater than 0 parcels		O&M	
• Tolay Extended		16		⊙
• Adobe Road		20[3]		⊙
• Tolay Confined		16		⊙

Table 4.5-7

Groundwater Impacts by Component - Storage Reservoirs, Criteria 2 to Criteria 5

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
• Lakeville Hillside		10		⊙
• Sears Point		10		⊙
• Two Rock		40		⊙
• Bloomfield		20		⊙
• Carroll Road		8		⊙
• Valley Ford		3		⊙
• Huntley		20		⊙
5.5.3. Will the storage reservoir component cause groundwater mounding or increase groundwater levels that cause surface water discharge in a non-stream environment?	Groundwater raised to within 6 feet of the surface		O&M	
• Bloomfield, Carroll Road, Valley Ford, Huntley		Within 6 feet of the surface or shallower[3]		⊙
• All other reservoirs		Groundwater would be more than 6 feet from the surface		○
5.5.4. Will the storage reservoir component lower groundwater levels at existing wells?	Greater than 0 wells		O&M	
• Tolay and Sears Point		0		==
• Adobe Road		2		⊙
• Lakeville Hillside		2		⊙
• Two Rock		15		⊙
• Bloomfield		2		⊙
• Carroll Road		9		⊙
• Valley Ford		1		⊙
• Huntley		3		⊙
5.5.5. Will the storage reservoir component lower groundwater levels in areas that could have been developed for future water supply?	Greater than 0 parcels		O&M	
• Tolay Extended		10		⊙
• Adobe Road		5[4]		⊙
• Tolay Confined		10		⊙

Table 4.5-7

Groundwater Impacts by Component - Storage Reservoirs, Criteria 2 to Criteria 5

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
• Lakeville Hillside		7		⊙
• Sears Point		7		⊙
• Two Rock		20		⊙
• Bloomfield		5		⊙
• Carroll Road		4		⊙
• Valley Ford		3		⊙
• Huntley		7		⊙

Source: Parsons Engineering Science, Inc., 1996

Notes: 1. Type of Impact:
O&M Operation and Maintenance

2. Level of Significance:
= No impact
○ Less than significant impact; no mitigation proposed
⊙ Significant impact before mitigation; less than significant impact after mitigation

3. 20 parcels are located east of Adobe Road, approximately 1,000 parcels are located west of Adobe Road where future development would be on municipal water.
4. Refer to *Hydrogeology of Storage/Reuse Areas and Potential Impacts to Groundwater* (Parsons Engineering Science, Inc. 1996a).

Impact: **5.5.2. Will the storage reservoir component degrade groundwater quality at future drinking water wells, resulting in a public health hazard?**

Analysis: *Significant; Alternatives 2 and 3.*

As discussed in impact 5.5-1, above, operation of storage reservoirs could degrade groundwater quality in the vicinity of the reservoir. Groundwater at all the reservoir sites travels slowly and impacts will not occur for many years into the future. For the purposes of this analysis, the area of potential future groundwater impacts is defined by the 20 percent or greater contribution zone. Impacts range from 3-40 developable parcels at the various reservoir sites.

No Impact; Alternatives 1, 4, and 5.

These alternatives do not have a storage reservoir component.

Mitigation: *Alternatives 2 and 3.*

2.3.12. Provide replacement water supply for affected wells.

Alternatives 1, 4, and 5. No mitigation is needed.

After Mitigation: *Less than Significant after Mitigation; Alternatives 2 and 3.*

With provision of an alternate water supply, where needed, this impact will no longer be significant. This mitigation measure has secondary growth-inducing impacts discussed in Chapter 5.3.

Impact: 5.5.3. Will the storage reservoir component cause groundwater mounding or increase groundwater levels that cause surface water discharge in a non-stream environment?

Analysis: As indicated in the Methodology section, a two-dimensional analytical model was used to evaluate potential groundwater mounding impacts at reservoir sites. The results of that evaluation indicate that there will be a moderate rise of groundwater within the vicinity of some of the reservoirs (Parsons Engineering Science, Inc. 1996a).

Construction of reservoirs will result in a maximum increase in groundwater levels of 18 feet under the reservoir footprint at Adobe Road. The potential impact of groundwater mounding is related to existing groundwater levels. Modest increases in areas where the groundwater occurs at depth will not result in near surface groundwater. However, slight mounding in areas with shallow groundwater could affect leachfield operations.

Significant; Alternatives 3B, 3C, 3D, and 3E.

Groundwater mounding calculations that assumed unconfined conditions (Parsons Engineering Science, Inc. 1996a) indicate that after reservoir construction at Carroll Road, Bloomfield, and Huntley, groundwater could rise to within 6 feet or less of the ground surface downgradient of the dam. The groundwater level at Valley Ford will be about 6 feet below the ground surface. Although listed as a significant impact, semi-confined groundwater conditions in the Americano Creek area will probably reduce the magnitude of groundwater mounding and adverse impacts are not likely to occur.

Less than Significant; Alternatives 2 and 3A.

Reservoir construction at all other reservoirs will not cause groundwater to rise to within 6 feet of the ground surface.

No Impact; Alternatives 1, 4, and 5.

These alternatives do not have a storage reservoir component.

Mitigation: *Alternatives 3B, 3C, 3D, and 3E.*

2.5.9. Implement a septic system monitoring and replacement program.

Alternatives 1, 2, 3A, 4 and 5. No mitigation is proposed.

After Mitigation: *Less than Significant after Mitigation; Alternatives 3B, 3C, 3D, and 3E.*

Monitoring of septic systems and replacement of affected systems with non-conventional systems, will reduce this impact to insignificant.

Impact: **5.5.4. Will the storage reservoir component lower groundwater levels at existing wells?**

Analysis: *Significant; Alternatives 2B, 2D, and 3.*

Surface water that enters the subsurface as interflow at a given reservoir site would be intercepted by the proposed dam. Therefore, the dam will intercept most upstream interflow. The water that will contribute to streamflow downstream of a proposed dam will be minimal and will be derived from "dam seepage". Consequently, wells screened in alluvial deposits or in weathered bedrock could lose groundwater interflow inputs and groundwater levels could decline.

Water supply wells are located downgradient of reservoirs in each subbasin. At the Sears Point, Two Rock, Bloomfield, and Carroll Road reservoir sites, downgradient wells are screened in alluvial deposits. These wells could be subject to groundwater level decreases following dam construction. Downgradient wells at Adobe Road, Lakeville Hillside, Valley Ford, and Huntley reservoir sites may be screened entirely or partially within alluvial deposits and could be adversely affected be groundwater level declines.

No Impact; Alternatives 1, 2A, 2C, 4, and 5.

No wells have been documented in the Tolay Creek watershed that could be affected by project-related decrease in groundwater levels.

Alternatives 1, 4, and 5 do not have a storage reservoir component.

Mitigation: *Alternatives 2B, 2D and 3.*

2.3.13. Monitor groundwater levels and provide replacement water supply.

Alternatives 1, 2A, 2C, 2D, 4, and 5. No mitigation is needed.

After Mitigation: *Less than Significant after Mitigation; Alternatives 2B, 2D, and 3.*

With provision of an alternate water supply, where needed, this impact will no longer be significant. This mitigation measure may have secondary growth-inducing impacts discussed in Chapter 5.3.

Impact: **5.5.5. Will the storage reservoir component lower groundwater levels in areas that could have been developed for future water supply?**

Analysis: *Significant; Alternatives 2 and 3.*

As discussed in impact 5.5-4, above, operation of storage reservoirs could result in groundwater depletion immediately downgradient of the dam. The areas that could be subject to groundwater depletion in the vicinity of the reservoir sites are shown in Figures 4.5-2 through 4.5-10.

No Impact; Alternatives 1, 4 and 5.

These alternatives do not have a storage reservoir component.

Mitigation: *Alternatives 2 and 3.*

2.3.13. Monitor groundwater levels and provide replacement water supply.

Alternatives 1, 4 and 5. No mitigation is needed.

After Mitigation: *Less than Significant after Mitigation; Alternatives 2 and 3.*

With provision of an alternate water supply, where needed, this impact will no longer be significant. This mitigation measure may have secondary growth-inducing impacts discussed in Chapter 5.3.

Pump Station Component

Impact: **5.6.1-5. Will the pump station component impact groundwater based on evaluation criteria 1-5?**

Analysis: *No Impact; All Alternatives.*

Pump stations will not interact with groundwater or cause an increase or decrease in recharge.

Alternatives 1 and 5 do not have a pump station component.

Mitigation: No mitigation is needed.

Agricultural Irrigation Component

Table 4.5-8

Groundwater Impacts by Component - Agricultural Irrigation

Evaluation Criteria	Point of Significance	Impact	Type of Impact	Level of Significance
5.7.1. Will the agricultural irrigation component degrade groundwater quality at existing drinking water wells, resulting in a public health hazard?	a. Nitrate levels in groundwater greater than 10 mg/L b. Greater than 0 wells in 20% contribution zone c. Less than 6 months travel time from reservoir to well d. Less than 500 feet from reservoir to well	<10 mg/L These points of significance are not applicable for irrigation	O&M, O&M-CP	❍
5.7.2. Will the agricultural irrigation component degrade groundwater quality at future drinking water wells, resulting in a public health hazard?	Greater than 0 parcels	0 parcels	O&M, O&M-CP	==
5.7.3. Will the agricultural irrigation component cause groundwater mounding or increase groundwater levels that cause surface water discharge in a non-stream environment?	Groundwater that is raised to within 6 feet of the surface	None within 6 feet of the ground surface	O&M, O&M-CP	❍
5.7.4. Will the agricultural irrigation component lower groundwater levels at existing wells?	Greater than 0 wells	0	O&M	==
5.7.5. Will the agricultural irrigation component lower groundwater levels in areas that could have been developed for future water supply?	Greater than 0 parcels	0	O&M	==

Source: Parsons Engineering Science, Inc., 1996

Notes:	1. Type of Impact:		2. Level of Significance:
O&M	Operation and Maintenance	==	No impact
O&M-CP	Operation and Maintenance - Contingency Plan	❍	Less than significant impact; no mitigation proposed

Impact: **5.7.1. Will the agricultural irrigation component degrade groundwater quality at existing drinking water wells, resulting in public health hazards?**

Analysis: *Less than Significant; Alternatives 2 and 3.*

Nitrate is the only constituent of concern because nitrate is present in reclaimed water at levels that exceed the MCL for drinking water. Nitrate levels in reclaimed water, applied in accordance with the proposed irrigation management plan, are below the nitrate requirements of crops. Therefore, nitrate in reclaimed water will be almost entirely taken up by the plants and will not migrate beyond the root zone. Although small amounts of nitrate do migrate through the root zone to enter the groundwater, the total input of nitrate to the groundwater will not be expected to measurably elevate nitrate levels in groundwater (Questa Engineering Corporation 1995b, Parsons Engineering Science, Inc. 1996b).

Agricultural irrigation could result in minor increases in salinity of groundwater, which is measured as total dissolved solids (TDS), but these will not be of public health concern. The City's reclaimed water is low in salinity, with an average TDS of 444 mg/L. This is below both the secondary MCL of 500 mg/L for TDS and the level of 3,000 mg/L at which water becomes unsuitable for municipal or domestic water supply. Existing TDS in groundwater at project monitoring wells ranged from about 300 mg/L to 1,000 mg/L. Based on the quality of reclaimed water, the potential for changes in salinity is minor, and will not be expected to impair beneficial uses of groundwater.

Application of reclaimed water in portions of the bay flats that are underlain by Reyes soils could result in the transport of salts and metals to shallow groundwater if programmed over-irrigation is implemented. Reyes soils are naturally acidic, with pH generally less than 4.0, and have shallow groundwater conditions (groundwater levels less than five feet below the ground surface). Metals that are not normally soluble may become soluble in acidic environments. Irrigation in previously unirrigated areas could result in flushing of metals and salts from the soil to the shallow groundwater. Shallow groundwater in the bay flats is brackish and is not considered to be potable. Therefore no significant health-related groundwater quality impacts will result. However, the movement of salts and metals from the soil to the groundwater and potentially to plants could adversely affect agricultural production within the bay flats irrigation area. Measures 2.2.1 and 2.2.3 included as part of the Project, provide for management of irrigation in the bay flats so as to avoid these potential adverse affects.

Accidental runoff or ponding from agricultural irrigation will be a temporary event that would not significantly alter groundwater quality.

No Impact; Alternatives 1, 4, and 5.

These alternatives do not have an agricultural component.

Mitigation: No additional mitigation is proposed.

Impact: 5.7.2. Will the agricultural irrigation component degrade groundwater quality at future drinking water wells, resulting in a public health hazard?

Analysis: *No Impact; All Alternatives.*

Although minor changes in groundwater quality may occur as described in Impact 5.7.1, no wells, either existing or future, will experience a change in quality sufficient to exceed standards or create a public health hazard.

Accidental runoff or ponding from agricultural irrigation will not impact future groundwater quality.

Alternatives 1, 4 and 5 do not have an agricultural irrigation component.

Mitigation: No mitigation is needed.

Impact: 5.7.3. Will the agricultural irrigation component cause groundwater mounding or increased groundwater levels cause surface water discharge in a non-stream environment?

Analysis: *Less than Significant; Alternatives 2 and 3.*

A water balance evaluation of potential impacts of reclaimed water application in Americano, Stemple, and Tolay creeks (Questa Engineering Corporation 1995a) indicates that most of the water that infiltrates past the root zone moves laterally along horizontal zones of preferential flow and discharges to ephemeral streams. Subsurface flow is influenced by shallow zones of relatively high permeability alluvium and/or surficial weathered material that is underlain by unweathered rock with lower permeability. Low permeability zones inhibit deep infiltration and most of the precipitation and irrigation water that infiltrates into the soil enters the "shallow groundwater return flow" regime (also referred to as interflow) and becomes surface water. In West County and the Tolay area this is expected to result in measurable discharges to local streams. Little, if any, of the irrigated water will infiltrate into the regional groundwater system and groundwater mounding will not result.

Subsurface conditions in the West Sebastopol area are similar to those in the Americano Creek watershed (i.e., horizontal beds of Wilson Grove Formation overlain by thin deposits of alluvium along stream valleys). Subsurface conditions in the Lakeville agricultural irrigation area are similar to those in the Tolay Creek watershed (i.e., Petaluma Formation bedrock). Because of these similar subsurface conditions at these sites it is assumed that infiltrating water will follow horizontal pathways; significant amounts of irrigation water will not enter the regional groundwater system

and groundwater mounding will not occur. In the Lakeville and Sebastopol areas, irrigation is not expected to discharge to surface water because of the irrigation management practices that are adopted as part of the Project, as specified in Section 2.2, and the wide dispersal of irrigation sites.

Subsurface conditions at East Rohnert Park, North Petaluma (Petaluma, North and Adobe Road) and bay flats agricultural irrigation areas are not analogous to those of the West County and/or the Tolay Creek watershed. Potential groundwater contributions in these agricultural irrigation areas were evaluated using a two-dimensional analytical model (WinFlow, Environmental Simulation 1995). Model results indicate that regional groundwater levels will rise less than five feet in the East Rohnert Park and North Petaluma areas. Given the conservative assumptions used in the modeling, increases in groundwater levels in the vicinity of these irrigation areas will probably be negligible (Parsons Engineering Science, Inc. 1996a).

The bay flats area is underlain by fine-grained, very low permeability deposits. Questa Engineering Corporation (1995a) found that the bay flats area along the lower Petaluma River and adjacent to San Pablo Bay does not drain and discharge naturally to local streams or the bay. These near-tidal areas require surface water drainage systems and groundwater pumping to maintain the water table at depths of about five feet below the ground surface. The addition of any irrigation water will contribute to a rise in the existing shallow groundwater level and will require increased pumping. Drainage conditions throughout much of the bay flats, particularly in the Reyes soils, preclude the use of standard, permitted septic systems. Therefore, groundwater mounding will not affect leachfield operations.

Reclaimed water that enters the shallow through-flow will travel through the shallow unsaturated zone where leachfields are located (approximately upper five feet). Because irrigation will occur during the dry summer season when minimal amounts of perched water are present, it is unlikely that leachfields will be adversely affected by the reclaimed water.

No impacts will result in irrigation areas that are currently being irrigated with other water sources or in areas where drip irrigation systems are in use.

Accidental ponding or runoff from agricultural irrigation will not be sufficient in quantity or duration to cause groundwater mounding.

No Impact; Alternatives 1, 4, and 5.

These alternatives do not have an agricultural irrigation component.

Mitigation: No additional mitigation is proposed.

Impact: **5.7.4. Will the agricultural irrigation component lower groundwater levels at existing wells?**

Analysis: *No Impact; All Alternatives.*

Application of reclaimed water for agricultural irrigation will not result in decreased groundwater levels because no surface or subsurface flow into the groundwater will be intercepted or blocked by Project facilities. Accidental ponding or runoff will not decrease groundwater levels.

Alternatives 1, 4, and 5 do not have an agricultural irrigation component.

Mitigation: No mitigation is needed.

Impact: **5.7.5. Will the agricultural irrigation component lower groundwater levels in areas that could have been developed for future water supply?**

Analysis: *No Impact; All Alternatives.*

Agricultural irrigation will not result in decreased groundwater levels because no pumping or other extraction is proposed. Accidental ponding or runoff will not affect future groundwater levels.

Alternatives 1, 4, and 5 do not have an agricultural irrigation component.

Mitigation: No mitigation is needed.

Geysers Steamfield Component

Impact: **5.8.1-5. Will the geysers steamfield component impact groundwater based on evaluation criteria 1 through 5?**

Analysis: *No Impact; All Alternatives.*

Injection of reclaimed water into deep wells at the geysers steamfield will not result in adverse groundwater impacts because of the poor quality and high temperature of existing water in the steamfield and because this water is not used for drinking water.

Injection of reclaimed water at the geysers steamfield will affect a groundwater sink several thousands of feet below the ground surface. According to the Bureau of Land Management, which manages the geothermal resource, Federal requirements will protect the upper 3,000 feet from any leakage and there is no known groundwater resource in the geysers area (Renee Snyder, Bureau of Land Management, Clear Lake Resource Area Manager, Letter 6/17/96).

Alternatives 1, 2, 3, and 5 do not have a geysers steamfield component.

Mitigation: No mitigation is needed.

Discharge Component

Impact: 4.9.1-5. Will the discharge component impact groundwater based on evaluation criteria 1 through 5?

Analysis: *No Impact; All Alternatives.*

Shallow groundwater conditions in the Santa Rosa Plain indicate that streams and rivers are discharge points for groundwater. During the winter months when groundwater levels are high, the prevailing hydrologic conditions will result in gaining streams (i.e. the groundwater would discharge into streams). Reclaimed water discharged into the Laguna or Russian River will not enter groundwater because the water table slopes toward the stream so that the hydraulic gradient of the aquifer is toward the stream (Fetter 1994). Discharge does not occur from May 15 to September 30, during the dry months.

Direct discharge will not result in decreased groundwater levels because no pumping or other extraction is proposed.

Mitigation: No mitigation is needed.

CUMULATIVE IMPACTS

There are five impacts -- either less than significant or significant -- identified in the Groundwater section:

Impact: 5.1 and 2C. Will the Project plus the cumulative projects degrade groundwater quality at drinking water wells, resulting in a public health hazards?

Analysis: Alternatives 2 and 3. Data on existing groundwater quality indicate there are existing high nitrate levels in some aquifers, especially near the Two Rock and Lakeville Hillside reservoirs. These nitrate levels were taken into consideration in the analysis of impacts. No further information on cumulative projects or trends in nitrate concentrations in groundwater have been identified. The impact of the Long-Term Project has been identified as significant, and cumulative impacts do not warrant changing either the finding or significance or the proposed mitigation.

Impact: 5.3.C. Will the Project and cumulative projects cause groundwater mounding or increase groundwater levels that cause surface water discharge in a non-stream environment?

Analysis: Alternatives 3B, 3C, 3D, 3E. No cumulative projects which could cause groundwater mounding have been identified within the aquifer serving the affected area downgradient of these reservoirs.

Impact: **5.4 and 5C. Will the Project and cumulative projects lower groundwater levels at existing and future wells?**

Analysis: No cumulative projects which could cause groundwater drawdown have been identified within the aquifer serving the affected area downgradient of these reservoirs.

SUMMARY OF SIGNIFICANT IMPACTS AND MITIGATION MEASURES

Table 4.5-9

Summary of Significant Impacts and Mitigation Measures – Groundwater

Evaluation Criteria	Level of Significance	Mitigation Measure
Storage Reservoir		
5.5.1. The storage reservoir component may degrade groundwater quality at existing wells, resulting in public health hazards.	Alt.2 - ⊙ Alt 3 - ⊙	2.3.12. Provide replacement water supply for affected wells.
5.5.2. The storage reservoir component may degrade groundwater quality at future drinking water wells, resulting in a public health hazard.	Alt.2 - ⊙ Alt 3 - ⊙	2.3.12. Provide replacement water supply for affected wells.
5.5.3. The storage reservoir component may cause groundwater mounding or increase groundwater levels that cause surface discharge in a non-stream environment.	Alt 3B - ⊙ Alt 3C - ⊙ Alt 3D - ⊙ Alt 3E - ⊙	2.5.9. Implement a septic system monitoring and replacement program.
5.5.4. The storage reservoir component may lower groundwater levels at existing wells.	Alt 2B - ⊙ Alt 2D - ⊙ Alt 3 - ⊙	2.3.13. Monitor groundwater levels and provide replacement water supply.
5.5.5. The storage reservoir component may lower groundwater levels in areas that could have been developed for future water supply.	Alt 2 - ⊙ Alt 3 - ⊙	2.3.13. Monitor groundwater levels and provide replacement water supply.

Source: Parsons Engineering Science, Inc., 1996

Notes:

⊙ Significant impact before mitigation; less than significant impact after mitigation

SUMMARY OF IMPACTS BY ALTERNATIVE

Table 4.5-10

Summary of Impacts by Alternative - Groundwater

Component	Alt 1	Alt 2A	Alt 2B	Alt 2C	Alt 2D	Alt 3A	Alt 3B	Alt 3C	Alt 3D	Alt 3E	Alt 4	Alt 5A	Alt 5B
No Action (No Project) Alternative	==	--	--	--	--	--	--	--	--	--	--	--	--
Headworks Expansion	--	==	==	==	==	==	==	==	==	==	==	==	==
Urban Irrigation	--	○	○	○	○	○	○	○	○	○	--	--	--
Pipelines	--	○	○	○	○	○	○	○	○	○	○	○	--
Storage Reservoirs	--	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	--	--	--
Pump Stations	--	==	==	==	==	==	==	==	==	==	==	--	--
Agricultural Irrigation	--	○	○	○	○	○	○	○	○	○	--	--	--
Geysers Steamfield	--	--	--	--	--	--	--	--	--	--	==	--	--
Discharge	--	==	==	==	==	==	==	==	==	==	==	==	==

Source: Parsons Engineering Science, Inc., 1996

Notes: Level of Significance Codes

- -- Not applicable
- == No impact
- ○ Less than significant impact; no mitigation proposed
- ⊙ Significant impact; less than significant after mitigation

PREPARERS, REFERENCES, AND CONSULTATION AND COORDINATION

Preparers

Sandia Potter R.G., Parsons Engineering Science, Inc.
Linda Stone R.G., Parsons Engineering Science, Inc.

Reviewers

Anders J. Hauge, Harland Bartholomew & Associates, Inc.
Patricia I. Collins, Harland Bartholomew & Associates, Inc.
Robin P. Cort, PhD, Parsons Engineering Science, Inc.
Mark Grismer, Peer Review Committee, U.C. Davis
John Cummings, Ph.D., Peer Review Committee
David Ziegler, Peer Review Committee

References

HBA Team Documents

Parsons Engineering Science, Inc. 1996a. *Hydrogeology of Storage/Reuse Areas and Potential Impacts to Groundwater.* (Appendix H-1).

Parsons Engineering Science, Inc. 1996b. *Well Installations and Groundwater Monitoring Results.* (Appendix H-4).

Questa Engineering Corporation. 1995a. *Baseline Hydrology and Irrigation Drainage Evaluation for West and South County Reclamation Alternatives.* September. (Appendix I-10).

Questa Engineering Corporation. 1995b. *Irrigation Nitrogen Loading to Groundwater.* October. (Appendix H-5).

Rust Environment and Infrastructure. 1995. *Geotechnical Assessment of Alternative Reservoir Sites and Pipeline Routes.* November. (Appendix F-1).

Other References

California Code of Regulations, Title 22, Section 60301 *et seq.* and Revised Wastewater Regulations, Title 22, Draft, dated 30 June 1993.

California Water Code, Division 7, Chapter 7, Section 13523.5.

California State Department of Water Resources in Cooperation with County of Sonoma. 1975. *Evaluation of Ground Water Resources: Sonoma County, Geologic and Hydrogeologic Data, Bulletin* 118-4. Volume 1, pp 177. December.

California State Department of Water Resources in Cooperation with the Sonoma County. 1982a. *Evaluation of Ground Water Resources: Sonoma County, Santa Rosa Plain.* Volume 2: pp 107. September.

California State Department of Water Resources in Cooperation with the Sonoma County. 1982b. *Evaluation of Ground Water Resources: Sonoma County.* Volume 3: pp 107. September.

State Water Resources Control Board. 1984. *Irrigation in With Reclaimed Municipal Wastewater A Guidance Manual, Report Number 84-1wr.* July.

California State Department of Water Resources. 1987. *Santa Rosa Plain Groundwater Model.* pp. 281. September.

Cardwell, G.T. 1958. *Geology and Ground Water in the Santa Rosa and Petaluma Valley Areas.* Sonoma County, California, U.S. Geological Survey Water-Supply Paper 1427. pp 273.

CH2M Hill. 1993. *Santa Rosa Subregional Water Reclamation System Draft Screening Evaluation of Long-Term Reclamation/Reuse Alternatives.* January.

CH2M Hill. 1990. *Santa Rosa Subregional Water Reclamation System Long-Term Detailed Reclamation Studies, Technical Memorandum No., R10, Water Quality Results from Quarterly Groundwater Sampling 1988/1989 in the Stemple/Americano Creeks Area.* February.

City of Santa Rosa and Bureau of Reclamation. 1990. *Environmental Impact Report for the Santa Rosa Subregional Long-Term Wastewater Project.*

Environmental Simulation. 1995. *Win Flow two-dimensional analytical model.*

Fetter, C. W. 1994. *Applied Hydrogeology, Third Edition.* MacMillan College Publishing Co.

Fox, K.F., Jr. 1983. *Tectonic Setting of Late Miocene, Pliocene, and Pleistocene Rocks in Part of the Coast Ranges North of San Francisco.* California, U.S. Geological Survey Professional Paper 1239. pp. 33.

North Coast Regional Water Quality Control Board. 1994. *Water Quality Control Plan for the North Coast Region.* amended 24 March.

U. S. Environmental Protection Agency. 1981. *Process Design Manual, Land Treatment of Municipal Wastewater.* October.

Consultation and Coordination

Persons Contacted

Daniel Carlson, City of Santa Rosa Utilities Department

Bob Hulquist, California Department of Health Services

Ted Walker, Sonoma County Environmental Health Department

Rich Holmer, Sonoma County Environmental Health Department

Bruce Anderson, Weeks Drilling

James Lopez, City of Petaluma Water Department

Chuck Rust, Santa Rosa Parks and Recreation

Rita Cardoza, Resident of Tolay Valley

Bruce Burton, California State Department of Health Services

Tuck Vath, North Coast Regional Water Quality Control Board

Correspondence

Renee Snyder, Clear Lake Resource Area Manager, Bureau of Land Management, letter dated 6/17/96

TABLE OF CONTENTS

LIST OF TABLES

4.6 SURFACE WATER QUALITY

This section discusses Project impacts on water quality constituents that will result from each project component. The water quality characteristics of Project reclaimed water, other wastewater discharges and potentially affected surface waters are also described in this section to provide a basis for the evaluation.

IMPACTS EVALUATED IN OTHER SECTIONS

Some issues that may affect surface water quality have been evaluated in other sections. Potential surface water quality impacts addressed in other sections are:

- Water Quality Related to Human Health. These issues are addressed in Section 4.7, Public Health and Safety.
- Water Quality Impacts on Aquatic Life. These issues are addressed in Section 4.9, Aquatic Biological Resources.
- Erosion Due to Construction. Erosion caused by construction within designated construction zones (e.g., dams and reservoirs) and outside of the aquatic environment (i.e., not in or adjacent to waterways) is addressed in Section 4.3, Geology, Soils, and Seismicity.
- Impacts Due to Dam Failure, are addressed in Section 4.19, Inundation Due to Dam Failure.

AFFECTED ENVIRONMENT (SETTING)

This section describes water quality conditions and regulations in waterways that are potentially affected by Project alternatives. The waterways within the Project area and potentially affected by the Project appear in Figures 4.4-1a and 4.4.1b (in the Surface Water Hydrology Section). Water quality conditions in the Russian River/Santa Rosa Plain, South County, West County, and the geysers area are described in distinct subsections below. The same water quality regulations relate to waterways in each of these areas, except for the Pacific Ocean. Water quality regulations for inland and ocean waters are described separately.

Water Quality Regulation

Surface water quality is regulated to protect aquatic life and human health according to the provisions of the Federal Clean Water Act (and associated federal regulations) and the California Porter-Cologne Water Quality Control Act, referred to respectively as the Federal and State Acts. The State Act established the nine Regional Water Quality Control Boards (Regional Boards) and the State Water Resources Control Board (State

Board). In California, the discharge permitting provisions of the Federal Act have been delegated by U.S. EPA to the State and Regional Boards. The Federal Act has led to the development of aquatic life water quality criteria (enforceable) and water quality guidelines (non-enforceable); the State Act has led to water quality objectives (enforceable) to protect aquatic life from adverse impacts for numerous water quality constituents. The criteria, guidelines, and objectives are hereinafter referred to collectively as criteria.

Water quality standards have also been developed to protect human health. Drinking water standards are established in federal regulations and in Title 22 of the California Code of Regulations, and requirements for wastewater reuse are established in Title 22. These regulations and water quality impacts are addressed in Section 4.7, Public Health and Safety.

Numeric and narrative water quality criteria have been developed by EPA and other agencies to protect aquatic life and to protect against aesthetic water quality impacts (see Merritt Smith Consulting 1996f for a detailed description of numeric and narrative criteria). Impacts of water quality on aquatic life and aesthetics that are addressed by the criteria are as follows:

- Biostimulation. Substances such as inorganic nutrients can stimulate plant production. This growth, known as biostimulation, of algae and other plant material can result in a fluctuation of dissolved oxygen in the surrounding waters. Dissolved oxygen is produced by photosynthesis and is consumed by plant and animal respiration and decay. Plant respiration and decay functions during the night often consume more oxygen that is supplied from transfer from the atmosphere to water and daytime photosynthesis. Dissolved oxygen is required for aquatic plants and animals, so the depletion that occurs in association with heavy algae blooms or other plant respiration is undesirable. Nitrogen is a plant growth nutrient and can be found in the form of nitrate and ammonia and incorporated in organic matter. No numeric criteria have been established by federal or state authorities for nitrogen compounds to prevent biostimulation, rather a narrative criterion has been established to limit biostimulatory effects and to control algae. Biochemical oxygen demand (often called BOD) is a measure of the amount of oxygen that is consumed by substances in water such as organic matter (which includes animal waste and algae).
- Toxicity and Bioaccumulation. Metals (e.g., copper and chromium) and organic compounds (e.g., pesticides, PCBs and petroleum products) can be toxic to aquatic life due to exposure to the compound in water or in food. Bioaccumulation occurs when a constituent accumulates in biological tissue to levels that exceed the concentration in the surrounding water. Some substances are toxic but do not bioaccumulate (e.g., salt and ammonia). Some substances are not toxic at the concentrations found normally in water, but are toxic at concentrations that can develop in prey (e.g., PCBs). Many metals for which criteria have been developed are required for normal plant or animal growth and

are toxic only at higher concentrations. Dissolved metals are generally more bioavailable (and thus toxic) than total metals. Therefore, most EPA water quality criteria for metals to protect aquatic life are based on dissolved metals concentrations rather than total metals concentrations.

- Physical and Habitat Effects. Some substances have damaging effects on habitat and/or organisms. For example, silt can affect fish and invertebrate gills and accumulate in the bottom of a creek rendering the creek unsuitable for organisms that require sand or gravel substrate. No numeric criteria have been established for physical substances, but narrative criteria have been established for turbidity, oil and grease, suspended matter, settleable matter, floating material, and color.
- Aesthetics. The narrative criteria cited above for physical and habitat effects also protect against aesthetic impacts.

This Surface Water Quality section focuses on water quality constituents that affect biostimulation, toxicity/bioaccumulation, physical/habitat and aesthetics of waters in the Project area.

Specific regulations that relate to inland and ocean surface waters are described below.

Inland Water Regulation

The inland surface waters in the Project area are within the jurisdiction of either the North Coast and the San Francisco Bay Regional Water Quality Control Boards (North Coast Regional Board and Bay Regional Board, respectively). Each Regional Board has a Water Quality Control Plan for basins within its jurisdiction (Basin Plan). The Basin Plans identify beneficial uses of waters, establish numeric and narrative objectives for protection of beneficial uses, and set forth policies to guide the implementation of programs to attain the objectives. In addition, federal criteria and guidelines for particular water quality constituents apply to waters to the extent that the Basin Plans do not include criteria for the constituents. The current Basin Plans used for this report are the Water Quality Control Plan for the North Coast Region dated August 1994 (North Coast Regional Board 1994) and the Water Quality Control Plan for the San Francisco Bay Basin Region dated December 1995 (Bay Regional Board 1995).

The North Coast Regional Board has established a Waste Reduction Policy (North Coast Regional Board 1995) for total nitrogen and ammonia for the Laguna de Santa Rosa in compliance with Section 303(d) of the federal Act. Dissolved oxygen and ammonia criteria are not currently attained in the Laguna and the Waste Reduction Policy sets load reduction goals for nitrogen and ammonia sources, including the Subregional System, such that the criteria will be attained.

The EPA and State Water Resources Control Board have established antidegradation policies. The federal policy, which is set forth in 40 CFR 131.12, states that:

- Existing instream water uses and the water quality necessary to protect existing uses (e.g., fish spawning, municipal water supply, and warm water aquatic habitat) shall be maintained and protected; and
- Where the quality of waters exceeds levels necessary to support beneficial uses, that quality shall be maintained and protected unless the State finds that allowing water quality degradation is necessary to accommodate important economic or social development in the area in which the waters are located. In allowing water quality degradation, the State shall assure water quality is adequate to fully protect beneficial uses.

As required by 40 CFR 131.12, the State has developed an Antidegradation Policy that is consistent with the federal policy described above; the state policy is described in the Administrative Procedures Update of 2, July 1990 entitled *Antidegradation Policy Implementation for NPDES Permitting*. The Antidegradation Policy applies to inland surface waters, ocean waters, and groundwaters.

The State Antidegradation Policy includes a technical (water quality and beneficial use impacts) and a non-technical component (necessity for socioeconomic development, maximum public benefit).

- Technical. According to the Antidegradation Policy, the evaluation of Project impacts on many water quality constituents is necessary to evaluate impacts on water quality relative to appropriate water quality objectives and impacts on beneficial uses. The State Antidegradation Policy guidelines state that, for NPDES permitting, the antidegradation analysis is the responsibility of the Regional Board and that the Regional Board shall comment on notices of preparation (NOPs) to ensure that it has sufficient information to conduct the appropriate antidegradation analysis. The Regional Board provided comments to the City of Santa Rosa in response to the NOP, and these comments were an important basis for the study plan that was implemented. Ongoing consultation with the North Coast Regional Board through the study process occurred so that the study program could be adjusted as needed to meet their information needs. The study plan and resulting technical reports produced the technical information that is described in the State Antidegradation Policy as being needed by the Regional Board for their analysis and related finding.
- Non-technical. Determinations as to whether the proposed Project "is necessary to accommodate important economic or social development"

and whether "maximum public benefit" is not within the scope of this EIR/EIS.

Thus, a complete analysis of the consistency of proposed alternatives with the Antidegradation Policy is not possible in this EIR/EIS, nor is it necessary according to the State Antidegradation Policy. Therefore, a specific antidegradation policy evaluation criterion was not developed. However, the technical information in this document is intended to provide the basis for any findings that the Regional Board may be required to make.

Ocean Water Regulation

The State Board has established a Water Quality Control Plan for Ocean Waters of California (Ocean Plan). The Ocean Plan identifies beneficial uses of ocean waters, numeric and narrative objectives for protection of beneficial uses, and policies to guide the implementation of programs to attain the objectives. The numeric objectives in the Ocean Plan are the same as the applicable federal criteria and guidelines for saltwater. The current Ocean Plan to be used for this report is the Water Quality Control Plan - Ocean Waters of California dated March 1990.

Reclaimed Water Discharges

Permit Compliance

The quality of reclaimed water is regulated in the discharge permit issued by the Regional Board. The discharge permit imposes limits on biochemical oxygen demand, suspended solids, settleable solids, total coliform organisms, chlorine residual, pH, turbidity and acute toxicity. The discharge permit also establishes a treatment effectiveness requirement. During the three-year period from 1992 through 1994, more than 18,920 determinations of compliance with the effluent limits and treatment effectiveness requirements were made by the Regional Board. Although 15 violations were reported during this period, the Regional Board found none of the violations to be significant and took no enforcement action. Each of the 15 violations related to pH or coliform. The rate of compliance with the effluent limits and treatment effectiveness requirements during the three-year period was 99.92% (18,905/18,920), which indicates a very reliable treatment system.

Reclaimed Water Quality

This section describes the quality of reclaimed water from the Laguna Treatment Plant. Water quality data collected and analyzed from 1988 through January 1995 (metals) and 1991 through January 1995 (organic and other compounds) were used in the evaluation of water quality impacts and are presented in Tables 4.6-1 (chemical constituents) and 4.6-2 (biological constituents). Generally, the data used for impact evaluations were from fresh effluent samples. The exception to

this is the evaluation of nitrogen compounds (organic nitrogen and ammonia). The concentration of these compounds is greatly affected by biological activity in the storage ponds, so the concentration in storage ponds was used for evaluation of impacts. The concentration of ammonia used was the average Delta Pond concentration from 1992 through February 1996. Samples for analysis of organic nitrogen in Delta Pond were begun in December 1995. Organic nitrogen from December 1995 through February 1996 averaged 1.25 mg/L. A concentration of 2 mg/L for organic nitrogen was used for waste load calculations to allow for uncertainty due to the short time frame for organic nitrogen data from Delta Pond. The concentration of nitrate-nitrogen used for the waste load reduction analysis was 14 mg /L which is estimated to be the concentration that will be obtained with proposed plant upgrades (CH2M Hill 1995b). The concentrations reported in Table 4.6-1 differ slightly from those reported in other sections of the EIR/EIS (Groundwater and Public Health and Safety) because collection of additional data for these compounds was conducted too recently to be included in the other sections. These slight differences do not affect analyses in other sections. Constituents that have been analyzed in reclaimed water and have not been detected are not included in Table 4.6-1.

Table 4.6-1

Detectable[1] Chemical Constituents of Reclaimed Water

Chemical	Concentration Range (mg/L)	Mean Concentration (mg/L)	Reporting Limit(s)[2] (mg/L)	Number of Detects	Number of Samples
Inorganics					
Total aluminum	N.D. - 0.15	0.032	0.01 - 0.10	20	27
Dissolved aluminum	N.D. - 0.04	0.011	0.01	2	8
Total ammonia-nitrogen (Delta Pond)	N.D. - 5.7	0.99 (as N)	0.1	70[3]	71[3]
Total arsenic	N.D. - 0.0040	0.0024	0.001 - 0.005	25	30
Dissolved arsenic	0.001 - 0.0030	0.0025	N/A	8	8
Asbestos, MFL[4]	N.D. - 0.56	0.25	0.05 - 0.28	2	4
Total barium	N.D. - 0.11	0.023	0.02 - 0.05	4	27
Boron	N.D. - 0.60'	0.48	0.10	17	18
Total cadmium	N.D. - 0.007	0.0007	0.0002 - 0.01	6	89
Calcium	22 - 63	31	N/A	19	19
Total chromium	N.D. - 0.014	0.0023	0.001 - 0.02	49	90
Total copper	N.D. - 0.04	0.012	0.005 - 0.10	88	90
dissolved copper	0.006 - 0.013	0.010	N/A	8	8
Cyanide	N.D. - 0.03	0.01	0.005 - 0.01	6	11
Fluoride	0:18 - 0.31	0.22	N/A	4	4

Table 4.6-1

Detectable[1] Chemical Constituents of Reclaimed Water

Chemical	Concentration Range (mg/L)	Mean Concentration (mg/L)	Reporting Limit(s)[2] (mg/L)	Number of Detects	Number of Samples
Total lead	N.D. - 0.020[5]	0.0045	0.001 - 0.04	19	90
Magnesium	15 - 23	19	N/A	18	18
Total mercury	N.D. - 0.0002	0.00037	0.0002 - 0.001	1	91
Total nickel	N.D. - 0.025[5]	0.0042	0.002 - 0.02	56	90
Dissolved nickel	N.D. - 0.0050	0.0034	0.005	6	8
Nitrate-nitrogen	0.3-50.5	14, 16.3[6]	N/A	49	49
Organic nitrogen (Delta Pond)	0.7 - 1.8	approx. 2	N/A	11	11
Nitrite	N.D. - 7.3	0.3 (as N)	0.01	45[3]	48[3]
Phosphate	0.1 - 8.4	4.3 (as P)	N/A	49[3]	49[3]
total potassium	6.6 - 24	11	N/A	28	28
Dissolved potassium	5.6 - 12	10	N/A	6	8
Total silver	N.D. - 0.010	0.0012	0.0001 - 0.01	40	88
Dissolved silver	N.D. - .005	.00072	.0001 - .0002	2	8
Total sodium	58 - 150	80	N/A	28	28
Total zinc	N.D. - 0.28	0.03	0.01 - 0.10	82	90
Dissolved zinc	0.01 - 0.058	0.032	N/A	8	8
Volatile Organics					
Acetone	N.D. - 0.0060	0.0042	0.002 - 0.01	2	14
Carbon disulfide	N.D. - 0.0370	0.0039	0.0005 - 0.005	3	14
Chlorobenzene	N.D. - 0.0001	0.00006	0.0001	1	19
1,4-dichlorobenzene	N.D. - 0.00090	0.00064	0.0005	10	13
Ethylbenzene	N.D. - 0.0010	0.00024	0.0001 - 0.0005	1	19
Methylene chloride	N.D. - 0.0060	0.00082	0.0001 - 0.003	5	19
Tetrachloroethylene	N.D. - 0.0006	0.00023	0.0001 - 0.0005	2	19
Toluene	N.D. - 0.0004	0.00023	0.0001 - 0.0005	2	19
1,1,1-trichloroethane	N.D. - 0.0002	0.00021	0.0001 - 0.0005	1	19
Xylenes	N.D. - 0.0002	0.00022	0.0001 - 0.0005	1	18
Halomethanes					
Bromomethane	N.D. - 0.0014	0.00026	0.0001 - 0.0005	1	19
Chloromethane	N.D. - 0.0050	0.00046	0.0001 - 0.001	1	19
Bromodichloromethane	N.D. - 0.0110	0.0022	0.0005	22	23
Chloroform	0.0024 - 0.0440	0.0099	0.0005	22	23
Dibromochloromethane	N.D. - 0.0021	0.00041	0.0001 - 0.0005	4	22
Total trihalomethanes[7]	0.0036 - 0.057	0.0129	N/A	23	23

Table 4.6-1

Detectable[1] Chemical Constituents of Reclaimed Water

Chemical	Concentration Range (mg/L)	Mean Concentration (mg/L)	Reporting Limit(s)[2] (mg/L)	Number of Detects	Number of Samples
Total halomethanes[7]		0.0134			
Phthalates[8]					
Di-n-butyl phthalate	N.D. - 0.0019	0.00116	0.001 - 0.005	2	23
Bis (2-ethylhexyl) phthalate	N.D. - 0.0060	0.00249	0.0006 - 0.005	5	23
diethyl phthalate	N.D. - 0.021	0.00193	0.0005 - 0.002	4	23
Total phthalates		0.00558			
Pesticides					
Aldicarb sulfone	N.D. - 0.0018	0.0011	0.0008	2	4
Aldicarb sulfoxide	N.D. - 0.0019	0.00081	0.0005	2	4
Aldrin	N.D. - 0.00003	0.0000086	0.00001 - 0.00005	3	19
DCPA (Dacthal)	N.D. - 0.0003	0.00021	0.0002	2	4
Endosulfan II	N.D. - 0.00001	0.0000059	0.00001-0.00002	1	19
α-BHC	N.D. - 0.00003	0.0000094	0.00001 - 0.00005	2	19
γ-BHC (Lindane)	N.D. - 0.00009	0.000022	0.00001 - 0.00002	8	19
Heptachlor	N.D. - 0.00003	0.0000083	0.00001 - 0.00005	1	19
Radioactivity					
Gross alpha, GPV[9]	1.3 - 5.5 pCi/L[10]	2.8 pCi/L	N/A	4	4
Gross beta, GPV	11.9 - 12.7 pCi/L	12.3 pCi/L	N/A	4	4

Source: *Reclaimed Water Quality*, Merritt Smith Consulting 1996k.

Period of record: Metals 1988 - Jan 1995, Organic and other compounds 1991 - Jan 1995.
N/A - not available
N.D. - not detected

[1] Analysis has been conducted for 21 total or dissolved metals and over 100 organic compounds in reclaimed water and each was below detection.

[2] Reporting limit is the lowest concentration that has been reported by the laboratories providing this data. Some of the listed reporting limits are not the lowest that can be reliably detected. The reporting limit is variable for specific compounds because analytical methods, laboratory technique, and presence of interfering compounds vary.

[3] Numbers shown are the number of monthly averages; these constituents are routinely measured several times per month

[4] Asbestos values are reported as millions of fibers per liter (MFL).

[5] The maximum concentration for these substances was half the detection limit of a non-detectable value This differs from *Human Health Risks from Chemical and Biological Components of Reclaimed Water* (Parsons Engineering Science, Inc. 1996c) which gives the maximum detectable value as the maximum.

[6] The two values for nitrate are the value estimated to be the concentration that will be obtained with proposed plant upgrades, and the long-term average reclaimed water concentration, respectively (Merritt Smith Consulting 1996k).

7 Trihalomethanes include chloroform, bromoform, bromodichloromethane, and dibromochloromethane. Bromoform was not detected at or above the reporting limit for any sample. One half the reporting limit for bromoform was used to calculate the maximum and mean concentrations of trihalomethanes. Total halomethanes includes total trihalomethanes (as above) plus bromomethane and chloromethane.

8 Phthalate numbers given here differ from those given in the *Human Health Risks from Chemical and Biological Components of Reclaimed Water* (Parsons Engineering Science, Inc. 1996c) because these numbers include additional data (See Appendix 5) collected while that technical report was prepared.

9 Radioactivity values are reported as greatest probable value (GPV).

10 pCi/L = pico Curies /L

Table 4.6-2

Biological Constituents of Reclaimed Water

Biological Constituent	Units	Concentration Range	Mean Concentration	Reporting Limits	Number of Detects	Number of Samples
BOD	mg/L	1.5 - 19	3.4		49[1]	49[1]
Total Coliform	MPN[2]/ 100 ml	ND - 170	2.2	2.2	49[1]	49[1]
Viruses	PFU[3]/#L	ND	N/A	1/~150 mL	0	7
Giardia lamblia	#cysts/ #L	ND - 28/203	10/223	1/~200 mL	2	4
Cryptosporidium	#oocysts/ #L	ND	N/A	1/~200 mL	0	4
Legionella sp.	MPN[2]/ 100 mL	ND	N/A	7840	0	4
Salmonella sp.	MPN[2]/ 100 mL	ND	N/A	2.2	0	4
Shigella	MPN[2]/ 100 mL	ND	N/A	2.2	0	4
Heterotrophic Bacteria Plate Count	CFU[4]/mL	ND - 2	1.25	2	1	4

Source: *Reclaimed Water Quality*, Merritt Smith Consulting 1996k

Period of record: 1991 - Jan 1995.
N/A - not available
N.D. - not detected
BOD - Biological Oxygen Demand

1 Numbers shown are the number of monthly averages; these constituents are routinely measured several times per month.
2 MPN - Most Probable Number
3 PFU - Plaque-Forming Units
4 Colony-Forming Units

Russian River and Santa Rosa Plain

This section describes water quality conditions and regulations in waterways that are potentially affected by this Project. The waterways (see Figure 4.4-1a, b, c) addressed in this section are as follows:

- Russian River. Includes the Russian River from Healdsburg to the mouth at the town of Jenner.
- Laguna de Santa Rosa. Includes the Laguna de Santa Rosa from Stony Point Road to its confluence with the Russian River, Santa Rosa Creek from Willowside Road to its confluence with the Laguna, and Mark West Creek from Slusser Road to its confluence with the Laguna.
- Mark West Creek. Water quality information is summarized for Mark West Creek at Slusser Road.
- Pacific Ocean. The Pacific Ocean is the ultimate recipient of river wastewater discharge and so is included in this section.

Creeks in the Sebastopol area are discussed under Sebastopol below.

Russian River

The Russian River from Healdsburg to the Pacific Ocean has several functions: habitat, potable water supply, aesthetics and recreation. It provides habitat for a variety of organisms, including migrating steelhead trout and coho as discussed in *Anadromous Fish Migration Study Program 1991-1995* Technical Report (Merritt Smith Consulting 1996b). To augment this resource, a steelhead coho hatchery is located downstream of Warm Springs Dam on Dry Creek, a tributary of the Russian River below Healdsburg. The Russian River is also a source of drinking water. Sonoma County Water Agency's primary source of water is a series of five Ranney collectors located in the gravel beneath the Russian River (City of Santa Rosa 1993). The Ranney collectors withdraw groundwater from the gravel beneath the River to provide drinking water for Sonoma County and portions of Marin County. The Russian River is also a major recreational resource. Many vacation homes are located along its banks, primarily below Wohler Bridge. It is also a popular destination for swimming, canoeing, fishing, and other water sports.

Water Quality

The following describes some of the main factors controlling water quality in the Russian River:

- Wastewater discharge. Between Healdsburg and Jenner, the Russian River receives treated wastewater from the cities of Healdsburg, Windsor, Occidental, Forestville, Graton, Guerneville, and Santa Rosa. The City of

Ukiah also discharges reclaimed water to the Russian River. Some of these discharges occur to percolation ponds located adjacent to the River.

- Warm Springs Dam. Water released from Warm Springs Dam on Dry Creek, a major tributary of the Russian River, at times comprises a large portion of the Russian River below Dry Creek.
- Summer check dams. In addition to the summer dam at Wohler operated by the Sonoma County Water Agency to provide water for their collectors, there are several other dams along the Russian River that are operated during the summer. The purpose of these dams is to provide recreational swimming areas. They result in a conversion of areas of the Russian River from a riverine habitat to a pond-like habitat.
- Watershed land uses. Uses of developed land in the Russian River watershed are primarily low density residential, recreation, agriculture, and gravel quarries. Among the potential water quality impacts from these land uses are coliforms, fertilizers, and pesticides (North Coast Regional Board 1995, CH2M Hill 1994a).

Water quality data collected on the Russian River by the Regional Board between September 1985 and October 1993 and by the HBA Team from May 1994 through February 1995 are summarized in Table 4.6-3. Additional bacteriological data have been obtained from the Sonoma County Water Agency (1993) and from the County of Sonoma Public Health Department. Data in Table 4.6-3 that are representative of conditions in the River above the Laguna are from Healdsburg Memorial Beach and Wohler Bridge. Data in Table 4.6-3 that are representative of conditions in the River below the Laguna are from Oddfellows Bridge and Johnson's Beach. Collections of samples for metals analysis were begun in May 1994. Metals data are summarized in Table 4.6-4. The complete data sets are available in the *Russian River Water Quality Monitoring Results* Technical Report (Merritt Smith Consulting 1996n).

Table 4.6-3

Average Seasonal Water Quality in the Russian River

	Above Laguna				Below Laguna			
	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall
Conductivity (µmhos/cm)	247	244	268	235	289	257	261	234
Turbidity (NTU)	4.45	8.86	3.28	0.88	9.16	9.38	3.90	1.13
Dissolved oxygen (mg/L)	11.6	9.8	8.8	9.4	11.8	9.5	8.7	9.4
Nitrate-Nitrogen (mg/L)	0.29	0.32	0.07	0.04	0.56	0.41	0.08	0.04
Ammonia-Nitrogen (mg/L)	0.04	0.03	0.04	0.04	0.12	0.05	0.03	0.07
TKN (mg /L)	0.25	0.18	0.23	0.23	0.28	1.15	0.26	0.21
Dissolved orthophosphate Phosphorous (mg/L)	0.02	0.03	0.01	0.01	0.20	0.10	0.04	0.03
Chlorophyll *a* (mg/L)	0.002	0.008	0.031	0.003	0.005	0.012	0.022	0.002
Total coliforms (MPN/100 mL)	706	306	248	104	737	210	292	302
Fecal coliforms (MPN/100 mL)	52.7	46.0	146.6	17.9	169.3	28.1	43.7	17.0

Source: *Russian River Water Quality Monitoring Results*, Merritt Smith Consulting 1996n

Period of record: 1985 - October 1993 and May 1994 - February 1995
µmhos/cm = micro mhos per centimeter
NTU = Nephelometric Turbidity Units
TKN = Total Kjeldahl Nitrogen = sum of organic nitrogen and ammonia concentrations
MPN = most probable number. The means are calculated as geometric means.

Table 4.6-4

Concentrations of Detectable[1] Metals in the Russian River
(mg/L)

Constituent	Above Laguna	Below Laguna	EPA Criteria[2]
Total aluminum	0.15	not analyzed	0.087
Total barium	0.073	not analyzed	none
Total chromium	0.0081	0.0060	none
Total copper	0.0082	0.0076	none
Total lead	0.0020	0.0024	none
Total nickel	0.017	0.011	none
Dissolved nickel	ND (0.005)[3]	0.0028	0.182
Total silver	0.0014	0.0006	none
Total zinc	0.015	0.015	none
Dissolved zinc	ND (0.01- 0.05)[3]	0.090	0.121

Source: *Russian River Water Quality Monitoring Results*, Merritt Smith Consulting 1996n

[1] Metals analyzed for but not detectable at concentrations above the reporting limit include total antimony, total and dissolved arsenic, total beryllium, total and dissolved cadmium, dissolved chromium, dissolved copper, dissolved lead, total and dissolved mercury, dissolved nickel, total and dissolved selenium, dissolved silver, and total thallium.

[2] EPA criteria are for dissolved metals and are hardness related. The values shown are for a hardness (the sum of calcium and magnesium concentrations as $CaCO_3$) of 119 mg/L which is the long-term average for the Russian River.

[3] ND indicates all values were below reporting limit. Reporting limits are in parentheses.

Two samples were collected from the Russian River above the Laguna in fall of 1994 for analysis of viruses. The results of these analyses were 1 plaque-forming unit (PFU) in 45 liters and 0 PFU in 153 liters.

The concentration of various organic compounds in the Russian River has been measured in samples collected by the Regional Board at several stations above and below the Laguna during 1985-86 and by the HBA Team above the Laguna in 1994. There were no detectable levels of organic compounds in the 1985-86 study. In the 1994 study, over 100 organic compounds were analyzed on four occasions. Only two, di(2-ethylhexyl)phthalate (a common laboratory contaminant from plastics) and simazine (a pesticide), were found at detectable concentrations on one occasion. These concentrations were 0.7 µg/L and 0.08 µg/L, respectively. Samples for analysis of pesticides were also collected weekly on the Russian River near Guerneville between August 1994 and January 1995 by the California EPA Department of Pesticide Regulation. Out of the 26 samples collected during this study, only one sample had a detectable pesticide, diazinon, which was detected at a concentration of 0.076 µg/L.

Benthic Algae and Macrophytes

The aquatic plant growth in the Russian River can be categorized into four types:

- Planktonic algae (small algae suspended in the water). The biomass of this component is estimated by chlorophyll a analysis. Chlorophyll data are included with chemical and physical water quality parameters described in Table 4.6-3.
- Benthic algae. This type consists of algae such as small diatoms and large filamentous *Cladophora* that are attached to the substrate (sand, gravel or cobble).
- Submergent macrophytes. This type consists of rooted higher plants which are mostly or completely below the surface of the water. In the Russian River there are three primary genera: *Elodea, Myriophyllum*, and *Ruppia* (*Ruppia* occurred only below Duncan's Mill). Submergent macrophytes were rare above Monte Rio during the 1994 study.
- Emergent macrophytes. This component consists of rooted higher plants which are mostly above the surface of the water. In the Russian River, this category is entirely water primrose. This plant grows along banks but sends out runners into the water. These runners have roots which take up water and nutrients from the water column.

The biomass of benthic algae and macrophytes was estimated in 1994 and the data are summarized in Table 4.6-5 through Table 4.6-7. Details on sample collection and a complete data set can be found in the *Russian River Algae and Macrophytes Assessment* (Merritt Smith Consulting 1996n). Samples were variable, and the averages have a high degree of variance.

Table 4.6-5

Biomass of Benthic Algae in Russian River

		Average Biomass (in mg chlorophyll *a*/m²)	
Sampling Date	**Substrate[1]**	**Stations Above Laguna[2]**	**Stations Below Laguna[2]**
May/June, 1994	sand	16 (n=2)	8 (n=1)
	gravel	2 (n=1)	11 (n=2)
	cobble	2 (n=1)	25 (n=6)
July, 1994	sand	17 (n=1)	101 (n=1)
	gravel	79 (n=2)	15 (n=4)

Table 4.6-5

Biomass of Benthic Algae in Russian River

Sampling Date	Substrate[1]	Average Biomass (in mg chlorophyll *a*/m²) Stations Above Laguna[2]	Stations Below Laguna[2]
	cobble	2 (n=1)	30 (n=7)
September, 1994	sand	10 (n=1)	8 (n=1)
	gravel	39 (n=2)	7 (n=3)
	cobble	5 (n=1)	15 (n=7)
May, 1995	sand	0 (n=0)	0.7 (n=1)
	gravel	0.2 (n=1)	2 (n=1)
	cobble	0.2 (n=1)	2 (n=2)
July, 1995	sand	21 (n=1)	18 (n=1)
	gravel	97 (n=3)	9 (n=3)
	cobble	3 (n=2)	11 (n=5)
August, 1995	sand	12 (n=2)	19 (n=3)
	gravel	8 (n=2)	12 (n=5)
	cobble	5 (n=1)	24 (n=5)

Source: *Russian River Algae and Macrophytes Assessment*, Merritt Smith Consulting 1996m

n Number of samples.

1 Substrate was defined for sampling locations as "sand" if only sand, as "gravel" if gravel-sized rocks (<1-inch diameter) occurred with sand, and "cobble" if cobble-sized rocks (>1-inch diameter) occurred with sand or gravel.

2 Benthic algae average biomass (in mg chlorophyll *a*/m2) for different substrate types above and below the confluence with the Laguna. Replicates were collected at various locations to represent cross-sections of the River. These replicates appear as averages in the table for like substrates.

Table 4.6-6

Biomass of Submergent Macrophytes in the Russian River below the Laguna

Sampling Date	Average Percent Cover	Average Wet Weight (g/m^2)
June, 1994	10 (n=6)	3700 (n=6)
September, 1994	23 (n=10)	2400 (n=7)
May, 1995	0[1]	0[1]
July, 1995	0[1]	0[1]
August, 1995	0[1]	0[1]

Source: *Russian River Algae and Macrophytes Assessment*, Merritt Smith Consulting 1996m

1 Visual observations made for submerged macrophytes detected none.

Table 4.6-7

Average Biomass of Emergent Macrophytes in Russian River (ft^2/River mile)

Sampling Date	Stations Above Laguna[1]	Stations Below Laguna[1]
June, 1994	1623	484
September, 1994	3283	1298
May, 1995	0[2]	0[2]
July, 1995	0[2]	0[2]
August, 1995	1946	861

Source: *Russian River Algae and Macrophytes Assessment*, Merritt Smith Consulting 1996m

1 Biomass average coverage in square feet per River mile.
2 Visual observations made for emergent macrophytes detected none.

Sediment Quality

Sediment quality data were collected in the Russian River during 1994 by the HBA Team and during 1985-86 by the Regional Board. The 1994 data (n=1) are presented in Table 4.6-8. Complete data and a more detailed data analysis are

found in the *Sediment Quality Characterization for the Russian River, Laguna de Santa Rosa, Santa Rosa Creek, and Wastewater Storage Ponds* Technical Report (Merritt Smith Consulting 1996o). All organic compounds analyzed were below detection limits with the exception of some phenolic compounds found in detectable concentrations above the confluence with the Laguna.

Table 4.6-8

Summary of Sediment Quality in the Russian River
(mg/kg or ppm wet weight)

Constituent	Above Laguna[1]	Below Laguna[1]	EPA Guidelines[2]
INORGANICS			
Antimony	ND (0.5)	ND (0.5)	
Arsenic	2.0	1.6	
Cadmium	ND (0.05)	ND (0.05)	
Chromium	51	50	
Cobalt	10	10	
Copper	13	12	
Lead	3.3	3.3	
Mercury	0.2	0.1	
Nickel	75	84	
Silver	ND (0.1)	ND (0.1)	
Zinc	36	34	
ORGANICS			
Chlorinated Dioxins and PCBs			
PCB-1016	ND (1.0)	ND (1.0)	
PCB-1248	ND (1.0)	ND (1.0)	
PCB-1254	ND (0.5)	ND (0.5)	
PCB-1260	ND (0.5)	ND (0.5)	
Semi-Volatiles			
Benzoic Acid	ND (1.6)	ND (1.6)	
Benzyl Alcohol	ND (0.33)	ND (0.33)	
Dibenzofuran	ND (0.33)	ND (0.33)	
Semi-Volatile, Organochlorines			
Aldrin	ND (0.012)	ND (0.012)	
Chlordane	ND (0.025)	ND (0.025)	

Table 4.6-8

Summary of Sediment Quality in the Russian River
(mg/kg or ppm wet weight)

Constituent	Above Laguna[1]	Below Laguna[1]	EPA Guidelines[2]
p,p'-DDD	ND (0.03)	ND (0.03)	
p,p'-DDE	ND (0.03)	ND (30.0)	
Dieldrin	ND (0.03, 0.011)[3]	ND (0.03, .015)[3]	0.011
Endrin	ND (0.03, 0.011)[3]	ND (0.03, .015)[3]	0.0042
Heptachlor	ND (1.0)	ND (1.6)	
Heptachor epoxide	ND (0.03)	ND (0.03)	
Hexachlorobenzene	ND (0.33)	ND (0.33)	
Hexachlorobutadiene	ND (0.33)	ND (0.33)	
g-BHC (Lindane)	ND (0.012)	ND (0.012)	
a-BHC	ND (0.003)	ND (0.003)	
b-BHC	ND (0.003)	ND (0.003)	
Semi-Volatile, Organophosphates			
Methyl Parathion	ND (0.0067)	ND (0.0067)	
Semi-Volatile, Phenolics			
2,4-Dimethylphenol	ND (0.33)	ND (0.33)	
2-Methyl Phenol	ND (0.33)	ND (0.33)	
4-Methyl Phenol	ND (0.33)	ND (0.33)	
Pentachlorophenol	2.0	ND (1.6)	
Phenol	1.2	ND (0.33)	
Semi-Volatile, Phthalates			
Butylbenzylphthalate	ND (0.33)	ND (0.33)	
Diethyl phthalate	ND (0.33)	ND (0.33)	
Dimethyl phthalate	ND (0.33)	ND (0.33)	
Di-n-octylphthalate	ND (0.33)	ND (0.33)	
Di-n-Butylphthalate	ND (0.33)	ND (0.33)	
Semi-Volatile, PAHs			
Acenaphthene	ND (0.33, 0.12)[3]	ND (0.33, 0.17)[3]	0.13

Table 4.6-8

Summary of Sediment Quality in the Russian River
(mg/kg or ppm wet weight)

Constituent	Above Laguna[1]	Below Laguna[1]	EPA Guidelines[2]
Acenaphthylene	ND (0.33)	ND (0.33)	
Anthracene	ND (0.33)	ND (0.33)	
Benzo(k)fluoranthene	ND (0.33)	ND (0.33)	
Benzo-a-pyrene	ND (0.33)	ND (0.33)	
Benzo(B)fluoranthene	ND (0.33)	ND (0.33)	
Benzo(g,h,i)perylene	ND (0.33)	ND (0.33)	
Chrysene	ND (0.33)	ND (0.33)	
Dibenzo (a,h)anthracene	ND (0.33)	ND (0.33)	
Fluoranthene	ND (0.33, 0.12)[3]	ND (0.33, 0.17)[3]	0.62
Fluorene	ND (0.33)	ND (0.33)	
Indeno(1,2,3-CD)pyrene	ND (0.33)	ND (0.33)	
2-Methylnaphthalene	ND (0.33)	ND (0.33)	
Naphthalene	ND (0.33)	ND (0.33)	
Phenanthrene	ND (0.33, 0.12)[3]	ND (0.33, 0.17)[3]	0.18
Pyrene	ND (0.33)	ND (0.33)	
Volatile, Aromatic & Halogenated			
1,2-Dichlorobenzene	ND (0.33)	ND (0.33)	
1,3-Dichlorobenzene	ND (0.33)	ND (0.33)	
1,2,4-Trichlorobenzene	ND (0.33)	ND (0.33)	

Source: *Sediment Quality Characterization for the Russian River, Laguna de Santa Rosa, Santa Rosa Creek, and Reclaimed Water Storage Ponds*, Merritt Smith Consulting 1996j

1 ND = concentration was below detection. Numbers in parentheses are reporting limits.

2 Blanks under EPA Guidelines indicate that there are no developed EPA guidelines, criteria or standards. Values given in this column are all guidelines, and guidelines are not considered enforceable by EPA.

3 Numbers in parentheses are reporting limits in mg/kg and reporting limits per gram organic carbon, respectively. EPA criteria are in units of mg/g organic carbon.

Wastewater Discharges Into the Russian River

Several community wastewater treatment plants discharge treated effluent directly into the Russian River; or indirectly to tributaries; or via subsurface flow from percolation ponds or quarries. Eight treatment plants (in addition to the Subregional System, which is described in Section 3.2, Description of Existing Conditions and Alternatives) operate within or upstream of the Project area:

- City of Ukiah
- City of Cloverdale
- City of Healdsburg
- Town of Windsor
- Occidental County Sanitation District
- Graton County Service Area
- Forestville County Sanitation District
- Russian River County Sanitation District (Guerneville)

A summary of the eight dischargers appears in Table 4.6-9. Discharge to the River and tributaries is prohibited in the dry season from May 15 through September 30. Discharge during the wet season ranges from 0.02 mgd (million gallons per day) from the Occidental plant to 2.43 mgd from the Ukiah plant. Five of the eight plants treat their wastewater to a secondary level. Windsor, Guerneville, and Ukiah treat their wastewater to a tertiary level before discharge. Cloverdale and Healdsburg discharge their treated effluent to ponds for percolation into the groundwater adjacent to the River. Discharges from the remaining six treatment plants enter the Russian River directly or via tributaries. Table 4.6-10 provides a summary of selected discharger monitoring data reported to the North Coast Regional Board.

Table 4.6-9

Wastewater Dischargers to the Russian River

Discharger	Avg Dry Weather Flow (mgd)[1]	Design Wastewater Flow (mgd)	Treatment	Receiving Water	Type of Discharge	Discharge Season	Facilities
Ukiah	2.4	2.8	secondary	Russian River	direct, limited to 1% of Russian River flow	Oct 1 - May 14	primary and secondary sedimentation, trickling filters, chlorination, oxidation/percolation ponds, dechlorination, sludge digestion
Cloverdale	0.5	0.7	secondary	percolation pond	indirect, percolation from pond	N/A	primary and secondary oxidation ponds, disinfection, percolation pond
Healdsburg	1.0	1.4	secondary	open pit quarry	indirect, percolation from quarry	N/A	four aerated ponds, two oxidation/sedimentation ponds, disinfection
Windsor	1.1	1.5	tertiary	Laguna at Trenton-Healdsburg	direct, limited to 1% of Laguna de Santa Rosa flow	Oct 1 - May 14	aerated ponds, settling, coagulation, flocculation, disinfection, storage
Occidental	0.02	0.05	secondary	Dutch Bill Creek	direct, limited to 1% of Dutch Bill Creek flow	Oct 1 - May 14	aerated pond, settling pond, disinfection
Graton	0.08	0.14	secondary	Atascadero Creek	direct, limited to 1% of Atascadero Creek flow	Oct 1 - May 14	aerated ponds, disinfection, storage
Forestville	0.05	0.1	secondary	Green Valley Creek	direct, limited to 1% of Green Valley Creek flow	Oct 1 - May 14	aerated ponds, disinfection, storage
Guerneville	0.35	0.71	tertiary	Russian River	direct, limited to 1% of Russian River flow	Oct 1 - May 14	aeration, clarification, coagulation, filtration, disinfection, solids dewatering

Source: North Coast Regional Water Quality Control Board. Data collected by dischargers 1994-1995

[1] 1994 data - average of 3 consecutive months of lowest flow.

Table 4.6-10

Russian River Wastewater Dischargers Monitoring Data [1]

Constituent [2]	Discharger							
	Ukiah	Cloverdale	Healdsburg	Windsor	Occidental	Graton	Forestville	Guerneville
BOD (mg/L)	NA	10, n=7	7, n=31	NA	18, n=20	6, n=1	7, n=1	6, n=20
Nitrate-Nitrogen (mg/L)	NA	NA	NA	7.1, n=12	NA	NA	NA	NA
Total coliform (MPN/100ml)	NA	25, n=7	44, n=38	ND (2), n=12	2, n=20	ND (2), n=1	ND (2), n=1	2, n=20
Chloroform (mg/L)	ND (0.0005), n=1	NA	NA	0.009, n=12	NA	0.026, n=1	0.001, n=1	0.034, n=5
Bromochloromethane (mg/L)	NA	NA	NA	NA	NA	0.110, n=1	0.101, n=1	NA
Dibromochloromethane (mg/L)	ND (0.0005), n=1	NA	NA	0.0012, n=12	NA	NA	NA	NA
Total Chromium (mg/L)	ND (0.020), n=1	NA	NA	ND (0.007), n=12	NA	NA	ND (0.005), n=1	NA
Copper (mg/L)	0.092, n=1	NA	NA	ND (0.050), n=12	NA	ND (0.005), n=1	0.010, n=1	NA
Lead (mg/L)	ND (0.005), n=1	NA	NA	ND (0.005), n=12	NA	NA	NA	NA
Mercury (mg/L)	ND (0.001), n=1	NA	NA	ND (0.001), n=12	NA	ND (0.0002), n=1	ND (0.0002), n=1	NA
Nickel (mg/L)	ND (0.050), n=1	NA	NA	NA	NA	ND (0.030), n=1	ND (0.030), n=1	NA
Silver (mg/L)	ND (0.010), n=1	NA	NA	NA	NA	ND (0.005), n=1	ND (0.005), n=1	NA
Zinc (mg/L)	ND (0.020), n=1	NA	NA	ND (0.050), n=12	NA	0.028, n=1	0.024, n=1	39, n=5

Table 4.6-10

Russian River Wastewater Dischargers Monitoring Data [1]

	Discharger							
Constituent [2]	**Ukiah**	**Cloverdale**	**Healdsburg**	**Windsor**	**Occidental**	**Graton**	**Forestville**	**Guerneville**
Hardness (mg/L)	122, n=1	NA	NA	140, n=12	NA	96, n=1	96, n=1	NA

Source: North Coast Regional Water Quality Control Board. Data collected by dischargers 1993-1995.

1 Effluent data were reported for sampling locations representative of the water quality entering the Russian River.
ND indicate the value is non-detectable (below the method detection limit) for that constituent. Value in parentheses is reporting limit.
Data set size is indicated by "n=__".

2 Constituents were selected to reflect the most prevalent constituents sampled for.

Laguna de Santa Rosa, Santa Rosa Creek, and Mark West Creek

The Laguna de Santa Rosa flows north across the Santa Rosa Plain to the Russian River. The dominant land use in the watershed is agricultural (30%) with open space and rural residential comprising 23 and 19% respectively (City of Santa Rosa 1994a). The lower portions of the Laguna, Santa Rosa Creek, and Mark West Creek serve as migration corridors for steelhead and coho salmon to spawning grounds in the upper reaches of Santa Rosa Creek and Mark West Creek (Merritt Smith Consulting 1995a).

Water Quality

Laguna water quality is affected by a number of factors, including the flow and quality of water in its tributaries, wastewater discharge from the City of Santa Rosa, runoff from urban and agricultural activities, and natural processes such as erosion, sedimentation, and algal growth. Water quality in the Laguna was found by the Regional Board to be impaired pursuant to Section 303(d) of the Federal Clean Water Act in 1982. The Regional Board found that water quality objectives, particularly for ammonia and dissolved oxygen, have been routinely exceeded. The Laguna de Santa Rosa Water Quality Objective Attainment Plan (City of Santa Rosa 1994a) identifies activities in the watershed that potentially affect ammonia and dissolved oxygen in the Laguna and quantified their load. The Plan concludes:

> Storm runoff from dairies was identified as the primary cause of ammonia exceedences in the Laguna. Storm runoff from dairies and urban areas was found to contribute organic matter and nutrients to the Laguna directly that result in algal growth and oxygen depletion. Discharges of groundwater carrying nutrients from septic systems and discharges of reclaimed water that occur late in the discharge season are believed to contribute nutrients that stimulate aquatic plant growth which leads to oxygen depletion. The relative importance of these nutrient and organic matter sources in determining Laguna water quality is unknown.

The Regional Board developed a waste reduction strategy for the Laguna de Santa Rosa (Regional Board 1995) as part of the process to bring the Laguna into attainment.

Water quality data for the Laguna, Santa Rosa Creek, and Mark West Creek are summarized in Tables 4.6-11-15. Data on the concentration of organic chemicals in the Laguna are not provided in these tables because the only detectable organic compound was gamma BHC (Lindane), which was found at a concentration of 1.1 µg/L on one occasion in Santa Rosa Creek at Stony Point Road. Details and complete data sets can be found in the *Laguna de Santa Rosa Water Quality Monitoring Results* Technical Report (Merritt Smith Consulting 1996j).

Table 4.6-11

Summary of Water Quality in the Laguna de Santa Rosa

	Above Santa Rosa Creek				Below Santa Rosa Creek			
	Winter	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**
Conductivity (µmhos/cm)	565	670	733	634	328	417	598	534
Turbidity (NTU)	20.2	27.4	28.9	24.5	8.8	22.1	21. 8	5.7
Dissolved oxygen (mg/L)	7.5	8.3	7.1	6.8	9.1	7.3	6.1	6.5
Nitrate-Nitrogen (mg/L)	4.23	1.60	0.25	0.52	1.95	0.95	1.06	0.59
Ammonia-Nitrogen (mg/L)	1.72	1.49	0.24	0.24	0.28	0.08	0.12	0.12
TKN (mg/L)	2.62	5.13	2.27	2.05	no data	no data	1.07	no data
Dissolved orthophosphate-phosphorous (mg/L)	1.47	1.48	1.13	0.74	0.93	0.63	0.41	0.21
Chlorophyll *a* (mg/L)	0.42	0.096	0.232	0.059	0.013	0.048	0.055	0.006

Source: *Laguna de Santa Rosa Water Quality Monitoring Results*, Merritt Smith Consulting 1996j

Period of record: August 1989 - August 1995
NTU = Nephelometric Turbidity Unit
TKN - Total Kjeldahl Nitrogen = sum of organic nitrogen and ammonia concentrations

Table 4.6-12

Concentrations of Detectable[1] Metals in the Laguna de Santa Rosa (mg/L)

Constituent	Above Santa Rosa Creek	Below Santa Rosa Creek	EPA Criteria[2]
Total arsenic	0.0042	0.0036	None
Total cadmium	ND (0.0005-0.005)[3]	0.0020	None
Total chromium	0.005	0.0059	None
Total copper	ND (0.005-0.02)[3]	0.012	None
Total lead	0.0018	0.0028	None
Total nickel	0.010	0.013	None
Dissolved nickel	0.0070	0.0059	0.198
Total silver	ND (0.01-0.001)[3]	0.0026	None
Total zinc	0.015	0.023	None

Source: *Laguna de Santa Rosa Water Quality Monitoring Results*, Merritt Smith Consulting 1996j

Period of record: June 1985 - May 1995

1 Metals analyzed for but not detected at concentrations above the reporting limit include dissolved arsenic, dissolved cadmium, dissolved chromium, dissolved copper, dissolved lead, total and dissolved mercury, total and dissolved selenium, dissolved silver, dissolved zinc.

2 EPA criteria are for dissolved metals and are hardness related. The value shown is for a hardness of 131 mg/L which is the average for the Laguna.

3 ND indicates all values were below the reporting limit. Reporting limits are in parentheses.

Table 4.6-13

Summary of Water Quality in Santa Rosa Creek

	Santa Rosa Creek at Willowside			
	Winter	**Spring**	**Summer**	**Fall**
Conductivity (μmhos/cm)	392	488	599	556
Turbidity (NTU)	16.0	8.5	2.3	2.0
Dissolved oxygen (mg/L)	10.7	11.8	9.1	10.0
Nitrate-nitrogen (mg /L)	2.16	0.98	0.15	0.45
Ammonia-nitrogen (mg /L)	0.12	0.19	0.07	0.12
TKN (mg /L)	0.38	1.07	0.57	1.59
Dissolved orthophosphate-Phosphorous (mg/L)	0.41	0.26	0.11	0.10
Chlorophyll *a* (mg/L)	0.005	0.010	0.016	0.003

Source: *Laguna de Santa Rosa Water Quality Monitoring Results*, Merritt Smith Consulting 1996j

Table 4.6-14

Concentrations of Detectable[1] Metals in Santa Rosa Creek (mg/L)

Constituent	Average Concentration at Willowside	EPA Criteria[2]
Total chromium	0.005	None
Total copper	0.004	None
Total lead	0.003	None
Total nickel	0.006	None
Dissolved nickel	0.004	0.183
Total zinc	0.033	None

Source: *Laguna de Santa Rosa Water Quality Monitoring Results*, Merritt Smith Consulting 1996j

[1] Metals analyzed for but not detected at concentrations above the reporting limit include total and dissolved arsenic, total and dissolved cadmium, dissolved chromium, dissolved copper, dissolved lead, total and dissolved mercury, total and dissolved selenium, total and dissolved silver, and dissolved zinc.

[2] EPA criteria are for dissolved metals and are hardness related. The value shown is for a hardness of 120 mg/L which is the average for Santa Rosa Creek.

Table 4.6-15

Summary of Water Quality in Mark West Creek at Slusser Road

	Winter	Spring	Summer	Fall
Conductivity (µmhos/cm)	228	274	492	461
Turbidity (NTU)	41.5	19.3	4.83	5.0
Dissolved oxygen (mg/L)	9.8	9.6	5.0	7.2
Nitrate-Nitrogen (mg/L)	5.8	0.30	1.11	0.15
Ammonia-Nitrogen (mg/L)	0.19	0.053	0.12	0.055
TKN (mg/L)	0.88	0.19	0.45	0.17
Dissolved orthophosphate phosphorus (mg/L)	0.016	0.13	0.12	0.22
Chlorophyll a (mg/L)	0.007	0.013	0.012	0.045

Source: *Laguna de Santa Rosa Water Quality Monitoring Results*, Merritt Smith Consulting 1996j

NTU = Nephelometric Turbidity Units
TKN = Total Kjeldahl Nitrogen = sum of organic nitrogen and ammonia concentrations

Sediment Quality

Sediment quality data have been collected in the Laguna and Santa Rosa Creek during 1994 by the Long-Term EIR/EIS Project Team and during 1985-86 by the Regional Board and are summarized in Tables 4.6-16 and 4.6-17. Complete data, including storage pond sediment quality data, and a more detailed data analysis thereof are found in the *Sediment Quality Characterization for the Russian River, Laguna de Santa Rosa, Santa Rosa Creek, and Wastewater Storage Ponds* Technical Report (Merritt Smith Consulting 1996o).

Table 4.6-16

Summary of Sediment Quality in the Laguna de Santa Rosa (mg/kg)

Constituent	Above Santa Rosa Creek[1]	Below Santa Rosa Creek[1]	EPA Guidelines[2]
INORGANICS			
Antimony	ND (0.5)	ND (0.5)	
Arsenic	1	1.7	
Cadmium	0.06	0.06	
Chromium	8.2	33	
Cobalt	3	8.2	
Copper	6.6	13	
Lead	3	7.9	
Mercury	ND (0.1)	ND (0.1)	
Nickel	11	38	
Silver	ND (0.1)	ND (0.1)	
Zinc	39	33	
ORGANICS			
Chlorinated Dioxins and PCBs			
PCB-1016	ND (1.0)	ND (0.5)	
PCB-1248	ND (1.0)	ND (0.5)	
PCB-1254	ND (0.5)	ND (0.2)	
PCB-1260	ND (0.5)	ND (0.2)	
Semi-Volatiles			
Benzoic Acid	ND (3.0)	ND (3.0)	
Benzyl Alcohol	ND (0.7)	ND (0.7)	
Dibenzofuran	ND (0.7)	ND (0.7)	
Semi-Volatile, Organochlorines			
Aldrin	ND (0.012)	ND (0.006)	
Chlordane	ND (0.25)	ND (0.10)	
p,p'-DDD	ND (0.030)	ND (0.020)	
p,p'-DDE	ND (0.030)	ND (0.020)	
Dieldrin	ND (0.030, 0.008)[3]	ND (0.020, 0.006)[3]	0.011
Endrin	ND (0.030 (0.008)[3]	ND (0.020 (0.006)[3]	0.0042
Heptachlor	ND (0.030)	ND (0.020)	
Heptachlor epoxide	ND (0.30)	ND (0.020)	

Table 4.6-16

Summary of Sediment Quality in the Laguna de Santa Rosa (mg/kg)

Constituent	Above Santa Rosa Creek[1]	Below Santa Rosa Creek[1]	EPA Guidelines[2]
Hexachlorobenzene	ND (0.70)	ND (0.70)	
Hexachlorobutadiene	ND (0.70)	ND (0.70)	
g-BHC (Lindane)	ND (0.012)	ND (0.006)	
a-BHC	ND (0.003)	ND (0.002)	
b-BHC	ND (0.003)	ND (0.002)	
Semi-Volatile, Organophosphates			
Methyl Parathion	ND (0.067	ND (0.067)	
Semi-Volatile, Phenolics			
2,4-Dimethylphenol	ND (0.70)	ND (0.70)	
2-Methyl Phenol	ND (0.70)	ND (0.70)	
4-Methyl Phenol	ND (0.70)	ND (0.70)	
Pentachlorophenol	ND (3.00)	ND (3.00)	
Phenol	12.00	ND (0.70)	
Semi-Volatile, Phthalates			
Butylbenzylphthalate	ND (0.70)	ND (0.70)	
Diethyl phthalate	ND (0.70)	ND (0.70)	
Dimethyl phthalate	ND (0.70)	ND (0.70)	
Di-n-octylphthalate	ND (0.70)	ND (0.70)	
Di-n-Butylphthalate	ND (0.70)	ND (0.70)	
Semi-Volatile, PAHs			
Acenaphthene	ND (0.70, 0.18)[3]	ND (0.70, 0.19)[3]	0.13
Acenaphthylene	ND (0.70)	ND (0.70)	
Anthracene	ND (0.70)	ND (0.70)	
Benzo(k)fluoranthene	ND (0.70)	ND (0.70)	
Benzo-a-pyrene	ND (0.70)	ND (0.70)	
Benzo(B)fluoranthene	ND (0.70)	ND (0.70)	
Benzo(g,h,i)perylene	ND (0.70)	ND (0.70)	
Chrysene	ND (0.70)	ND (0.70)	
Dibenzo (a,h)anthracene	ND (0.70)	ND (0.70)	
Fluoranthene	ND (0.70, 0.18)[3]	ND (0.70, 0.19)[3]	0.62
Fluorene	ND (0.70)	ND (0.70)	

Table 4.6-16

Summary of Sediment Quality in the Laguna de Santa Rosa (mg/kg)

Constituent	Above Santa Rosa Creek[1]	Below Santa Rosa Creek[1]	EPA Guidelines[2]
Indeno(1,2,3-CD)pyrene	ND (0.70)	ND (0.70)	
2-Methylnaphthalene	ND (0.70)	ND (0.70)	
Naphthalene	ND (0.70)	ND (0.70)	
Phenanthrene	ND (0.70, 0.18)[3]	ND (0.70, 0.19)[3]	0.18
Pyrene	ND (0.70)	ND (0.70)	
Volatile, Aromatic & Halogenated			
1,2-Dichlorobenzene	ND (0.70)	ND (0.70)	
1,3-Dichlorobenzene	ND (0.70)	ND (0.70)	
1,2,4-Trichlorobenzene	ND (0.70)	ND (0.70)	

Source: *Sediment Quality Characterization for the Russian River, Laguna de Santa Rosa, Santa Rosa Creek, and Reclaimed Water Storage Ponds*, Merritt Smith Consulting 1996o. EPA guidelines from EPA 1993 a-e.

1. ND = concentration was below detection. Numbers in parentheses are reporting limits.
2. EPA 1993a-e. Blanks under EPA Guidelines indicate that there are no developed EPA guidelines, criteria or standards. Values given in this column are all guidelines, and guidelines are not considered enforceable by EPA.
3. Numbers in parentheses are reporting limits in mg/kg and reporting limits per gram organic carbon, respectively. EPA criteria are in units of mg/g organic carbon.

Table 4.6-17

Summary of Sediment Quality in Santa Rosa Creek (mg/kg)

Constituent	Willowside	EPA Guidelines[1]
Inorganics		
Antimony	ND (0.5)	
Arsenic	1.1	
Cadmium	0.1	
Chromium	35	
Cobalt	8	
Copper	15	
Lead	13	
Mercury	ND (0.1)	

Table 4.6-17

Summary of Sediment Quality in Santa Rosa Creek (mg/kg)

Constituent	Willowside	EPA Guidelines[1]
Nickel	50	
Silver	ND (0.1)	
Zinc	47	
Organics		
Chlorinated Dioxins and PCBs		
PCB-1016	ND (1.0)	
PCB-1248	ND (1.0)	
PCB-1254	ND (0.5)	
PCB-1260	ND (0.5)	
Semi-Volatiles		
Benzoic Acid	ND (3.0)	
Benzyl Alcohol	ND (0.70)	
Dibenzofuran	ND (0.70)	
Semi-Volatile, Organochlorines		
Aldrin	ND (0.012)	
Chlordane	ND (0.25)	
p,p'-DDD	ND (0.030)	
p,p'-DDE	ND (0.030)	
Dieldrin	ND (0.030, 0.007)[3]	0.011
Endrin	ND (0.030, 0.007)[3]	0.0042
Heptachlor	ND (0.030)	
Heptachlor epoxide	ND (0.020)	
Hexachlorobenzene	ND (0.70)	
Hexachlorobutadiene	ND (0.70)	
g-BHC (Lindane)	ND (0.012)	
a-BHC	ND (0.003)	
b-BHC	ND (0.003)	
Semi-Volatile, Organophosphates		
Methyl Parathion	ND (0.067)	
Semi-Volatile, Phenolics		
2,4-Dimethylphenol	ND (0.70)	
2-Methyl Phenol	ND (0.70)	
4-Methyl Phenol	ND (0.70)	
Pentachlorophenol	ND (3.0)	
Phenol	ND (0.70)	

Table 4.6-17

Summary of Sediment Quality in Santa Rosa Creek (mg/kg)

Constituent	Willowside	EPA Guidelines[1]
Semi-Volatile, Phthalates		
Butylbenzylphthalate	ND (0.70)	
Diethyl phthalate	ND (0.70)	
Dimethyl phthalate	ND (0.70)	
Di-n-octylphthalate	ND (0.70)	
Di-n-Butylphthalate	ND (0.70)	
Semi-Volatile, PAHs		
Acenaphthene	ND (0.70, 0.15)[3]	0.013
Acenaphthylene	ND (0.70)	
Anthracene	ND (0.70)	
Benzo(k)fluoranthene	ND (0.70)	
Benzo-a-pyrene	ND (0.70)	
Benzo(B)fluoranthene	ND (0.70)	
Benzo(g,h,i)perylene	ND (0.70)	
Chrysene	ND (0.70)	
Dibenzo (a,h)anthracene	ND (0.70)	
Fluoranthene	ND (0.70, 0.15)[3]	0.62
Fluorene	ND (0.70)	
Indeno(1,2,3-CD)pyrene	ND (0.70)	
2-Methylnaphthalene	ND (0.70)	
Naphthalene	ND (0.70)	
Phenanthrene	ND (0.70, 0.15)[3]	0.18
Pyrene	ND (0.70)	
Volatile, Aromatic & Halogenated		
1,2-Dichlorobenzene	ND (0.70)	
1,3-Dichlorobenzene	ND (0.70)	
1,2,4-Trichlorobenzene	ND (0.70)	

Source: *Sediment Quality Characterization for the Russian River, Laguna de Santa Rosa, Santa Rosa Creek, and Reclaimed Water Storage Ponds*, Merritt Smith Consulting 1996o

1. ND = concentration was below detection. Numbers in parentheses are reporting limits.
2. EPA 1993a-e. Blanks under EPA Guidelines indicate that there are no developed EPA guidelines, criteria or standards. Values given in this column are all guidelines, and guidelines are not considered enforceable by EPA.
3. Numbers in parentheses are reporting limits in mg/kg and reporting limits per gram organic carbon, respectively. EPA criteria are in units of mg/g organic carbon.

Pacific Ocean

The Pacific Ocean is approximately 35 river miles from Santa Rosa by way of the Russian River. The character of seawater in the vicinity of Bodega Bay and the Russian River is influenced by large-scale water movements in the northern Pacific Ocean. Waters from the Subarctic and North Pacific water masses are carried into the area by the southward flowing California Current. The coastal waters are cool, as might be expected considering their northern origin. The highest water temperatures usually occur in August or September, and are near 55° F. Periods of minimum water temperatures often occur in the spring, when upwelling takes place. Upwelling is a phenomenon caused by strong winds that drive surface waters away from the coast. Cold, nutrient-rich waters from the bottom of the ocean rise, replacing the surface waters. In November and December, the effects of the Davidson Current, a weak, warm, northward-flowing current, are usually felt in the area.

Localized eddies are reported to exist south of Bodega Head. Current measurements made by the National Oceanic and Atmospheric Administration, off the mouth of the Russian River and near Sea Ranch, indicate that current reversals occur frequently along an axis parallel to the coastline (EIP 1991). These data suggest that nearshore eddies are probably occurring along the Sonoma coast.

An evaluation of the circulation of water and sediments to provide baseline information in the Bodega Bay region was conducted by Bodega Research Associates. The study reached the following conclusions (EIP 1991):

- The circulation of ocean waters seaward of Bodega Bay is highly dynamic; short-term variability is superimposed over seasonal shifts in current direction and velocity. Nearshore circulation patterns are influenced by numerous factors, including seasonal and daily wind patterns, tides, and local topography.
- Water circulation within Bodega Bay undergoes rapid changes under the influence of wind and tidal forces. Under some conditions, rapid mixing of Bodega Bay waters can occur, while at other times, poor mixing conditions exist. The degree of mixing is important to the dispersion of wastewater plumes. The reasons for the high variability of mixing conditions within Bodega Bay are complex and not fully understood.
- Water and sediments exiting from the Estero Americano become entrained into the circulation of Bodega Bay. Water movement is highly variable, depending on wind and tidal influences. The Estero plume has been observed to move in all possible directions at different times from the mouth of the Estero, including north or south along the eastern coast of Bodega Bay or west into Bodega Bay. The dispersion of the Estero plume is dependent on its volume and velocity, the velocity of Bodega Bay

currents, the relative temperatures and salinities of plume and Bay waters, and the degree of wind- and wave-induced turbulence.

Water quality in the Bodega Bay region is influenced during the winter months by freshwater outflow from the Russian River, Salmon Creek, and numerous small creeks.

Beneficial uses of the Pacific Ocean include recreation, aesthetic enjoyment, navigation, industrial water supply, commercial fishing, preservation and enhancement of fish, wildlife, and other marine resources. An Area of Special Biological Significance is located at Tomales Point, at the south end of Bodega Bay. The Bodega Marine Life Refuge was designated as an Area of Special Biological Significance by the State Water Resources Control Board. The Gulf of the Farallones National Marine Sanctuary includes the waters surrounding the Farallon Islands and Point Reyes including Estero Americano and Estero de San Antonio. The Sanctuary was designated by the National Oceanic and Atmospheric Administration in 1981 (15 CFR 936). The Cordell Bank National Marine Sanctuary includes the waters surrounding the Bank approximately 20 miles west of Point Reyes, and just north of the Farallone Islands (15 CFR 922-1000).

Sebastopol

Water bodies in the Sebastopol study area include Atascadero Creek and Green Valley Creek, the Laguna de Santa Rosa, and the Russian River. The affected environment of the Laguna and the River are described in the Santa Rosa Plain/Russian River section. Water bodies of the Sebastopol study area are shown in Figure 4.6-1.

Creeks

Atascadero Creek is a tributary to Green Valley Creek, which flows to the Russian River. Both creeks drain relatively large areas west of Sebastopol. The creeks are perennial and low gradient with large stretches without vegetative canopy. Water quality in the creeks of the Sebastopol study area is generally poor and is influenced by three major contributors in the watersheds that drain the area. The contributors are wastewater discharge, agriculture and livestock, and residential development.

Wastewater Discharges

Both creeks receive secondary-treated wastewater from local treatment plants. Atascadero Creek receives wastewater from the community of Graton. Green Valley Creek receives wastewater from Forestville. Discharges to the creeks occur in the winter and directly affect water quality. In the summer reclaimed water is used for irrigation, and irrigation can potentially influence water quality if reclaimed water is overapplied. Wastewater primarily contributes nutrients and suspended solids to the creeks.

Agriculture and Livestock

Much of the land in the Sebastopol study area is used for agriculture. Orchards and crop fields drain to both creeks. These practices potentially introduce herbicides and insecticides to the creeks during rainstorms. Influences from livestock grazing and feedlots are less significant than in West County owing to the small number of ranches and dairies. However, impacts from these activities include erosion, contributions of ammonia, lower dissolved oxygen, and, potentially, water diversions.

Residential Development

Although the creeks primarily drain rural areas, influences from residences, commercial businesses, and roads exist. Influences from residential development include stormwater runoff and illegal dumping into the creeks and tributaries. These impacts potentially introduce metals, oil and grease, fertilizers, insecticides, and solvents to the creeks.

Water quality data collected in September and May 1994, and May 1995 in Atascadero Creek and Green Valley Creek are shown in Table 4.6-18. Sampling was conducted in Atascadero Creek 1/4 mile west of Highway 101 on Occidental Road and in Green Valley Creek at Green Valley Road (between Graton and Harrison Grade Road).

Table 4.6-18

Summary of Water Quality Data in Sebastopol Area Creeks
(mg/L unless otherwise noted)

Constituent	Green Valley Creek [1]	Atascadero Creek [1]
Conductivity (µmhos)	280	284
pH	7.2	7.2
Total dissolved solids	258	255
Total suspended solids	12.3	22.2
Dissolved oxygen	7.0	5.7
Temperature (°C)	15.8	16.4
Chlorophyll *a*	ND (0.01)	0.28
Ammonia - Nitrogen	0.061	0.057
Nitrate - Nitrogen	0.086	0.106
Orthophosphate - Phosphorus	0.094	0.15
Total Organic Carbon	6.7	8.3
Arsenic, dissolved	ND (0.005)	ND (0.005)
Cadmium, dissolved	ND (0.005)	ND (0.005)

Table 4.6-18

Summary of Water Quality Data in Sebastopol Area Creeks
(mg/L unless otherwise noted)

Constituent	Green Valley Creek [1]	Atascadero Creek [1]
Chromium, dissolved	ND (0.005)	ND (0.005)
Copper, dissolved	ND (0.005)	ND (0.005)
Lead, dissolved	ND (0.003)	ND (0.003)
Mercury, dissolved	ND (0.0002)	ND (0.0002)
Nickel, dissolved	0.006	0.004
Selenium, dissolved	ND (0.005)	ND (0.005)
Silver, dissolved	ND (0.001)	ND (0.001)
Zinc, dissolved	0.030	0.045

Source: *Irrigation/Storage Streams Water Quality Monitoring Results*, Merritt Smith Consulting 1996i

1. Data are averaged for three dates (5/6/94, 9/20/94, 5/25/95). Data reported below the reporting limit (ND) are shown as the detection limit.

South County

The types of waterways in the South County Project area are as follows:

- **Creeks.** Creeks flow from hills across the Petaluma Plain or historic baylands to the Petaluma River or directly to San Pablo Bay.
- **Tidal Sloughs.** Petaluma River, Sonoma Creek and Tolay Creek each have a tidal segment and associated marsh.
- **San Pablo Bay.** San Pablo Bay is part of the San Francisco Bay Delta system.

Figures 4.4-1a and 4.4-1b shows the location of South County waterways, and the water quality setting of each is described below.

Creeks

Numerous seasonal creeks flow through the Project area, and water quality has been assessed in some of these creeks, as indicated in Table 4.6-19. Water quality in the portion of these creeks that is within the Project area is influenced by adjacent land uses (e.g., dairies and agriculture), but much less so than in the West County study area. The creeks are not known to have any particular water quality problem or unusual characteristics. The data described in Table 4.6-19 were collected as described in the *Irrigation/Storage Stream Water Quality Monitoring Results* Technical Report (Merritt Smith Consulting 1996i).

Table 4.6-19

Summary of Water Quality in South County Creeks

Constituent (in mg/L unless otherwise noted)	Tolay Creek at Sears Point	Tolay Creek at Hwy 121		Lakeville Storage Site (unnamed creek)	Adobe Creek at Adobe Road	Petaluma River at Corona Road	Crane Creek at Petaluma Hill Road
Date	May 25 1995	May 4 1994	May 24 1995	May 23 1995	May 4 1994	May 5 1994	May 4 1994
Ammonia - Nitrogen	0.06	0.16	0.07	0.07	ND[1] (0.05)	ND (0.05)	ND (0.05)
Un-ionized Ammonia - Nitrogen							
Chlorophyll	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)
Total Dissolved Solids	450	610	480	600	260	860	260
Total Suspended Solids	5	25	4.4	11	ND (4)	4.4	ND (4)
Dissolved Oxygen		7.4			8.65	9.7	7.4
Temperature (°C)		17.9			17.9	21	17
Nitrate-Nitrogen	ND (0.03)	ND (0.03)	ND (0.03)	ND (0.03)	ND (0 .03)	0.24	1.4
Arsenic, dissolved	0.007		0.010	0.006			
Cadmium, dissolved	ND (0.0005)	ND (0.0005)[2]	ND (0.0005)	ND (0.0005)	ND (0.0005)[2]	ND (0.0005)[2]	ND (0.0005)[2]
Chromium, dissolved	ND (0.005)	ND (0.005)[2]	ND (0.005)	ND (0.005)	ND (0.005)[2]	ND (0.005)[2]	ND (0.005)[2]
Copper, dissolved	ND (0.005)	ND (0.005)[2]	ND (0.005)	ND (0.005)	ND (0.005)[2]	ND (0.005)[2]	ND (0.005)[2]
Lead, dissolved	ND (0.002)	ND (0.002)[2]	ND (0.002)	ND (0.002)	ND (0.002)[2]	ND (0.004)[2]	ND (0.002)[2]
Mercury, dissolved	ND (0.0002)		ND (0.0002)	ND (0.0002)			

Table 4.6-19

Summary of Water Quality in South County Creeks

Constituent (in mg/L unless otherwise noted)	Tolay Creek at Sears Point	Tolay Creek at Hwy 121		Lakeville Storage Site (unnamed creek)	Adobe Creek at Adobe Road	Petaluma River at Corona Road	Crane Creek at Petaluma Hill Road
Nickel, dissolved	ND (0.005)	0.015[2]	0.007	0.008	ND (0.005)[2]	0.010[2]	ND (0.005)[2]
Selenium, dissolved	ND (0.005)		ND (0.005)	ND (0.005)			
Silver, dissolved	ND (0.001)	ND (0.001)[2]	ND (0.001)	ND (0.001)	ND (0.001)[2]	ND (0.001)[2]	ND (0.001)[2]
Zinc, dissolved	0.020	ND (0.01)[2]	ND (0.01)	ND (0.01)	ND (0.01)[2]	ND (0.01)[2]	ND (0.01)[2]

Source: *Irrigation/Storage Streams Water Quality Monitoring Results*, Merritt Smith Consulting 1996i

1 ND = concentration was below detection. Numbers in parentheses are reporting limits.
2 Denotes total metal analyzed, not dissolved metal

Tidal Sloughs

Water quality conditions in tidal sloughs in the South County study area are influenced by freshwater inflow and, in the Petaluma River, by wastewater discharges. Freshwater inflow interacts with Bay water in the sloughs to create seasonally variable salinity conditions. In summer and fall, salinity in the sloughs is similar to that of San Pablo Bay. In winter and spring, Bay water can be completely flushed from the sloughs by high freshwater inflows or, under lower inflow conditions, Bay water may remain in the slough and mix with freshwater inflow to create brackish conditions.

The City of Petaluma discharges wastewater to the Petaluma River from December to April. The City of Petaluma treats its wastewater to the secondary stage prior to discharge; however, plans for an alternative treatment system are being considered (City of Petaluma 1994). Table 4.6-20 summarizes the quality of effluent that is discharged.

Table 4.6-20

Summary of City of Petaluma Wastewater Quality

Constituent[1]	Mean	Standard Deviation
Flow (mgd)	5.2	
Ammonia - Nitrogen	7.77	5.033
Un-ionized Ammonia - Nitrogen	0.035	0.027
Chlorophyll	0.078	0.089
TDS	705.2	182.2
Dissolved Oxygen	7.46	3.32
Temperature (°C)	11.01	3.30
Cyanide	0.012	not available
Chromium	0.0046	not available
Copper	0.020	not available
Lead	0.0044	not available
Mercury	0.0003	not available
Nickel	0.016	not available
Selenium	ND (0.005)[2]	not available
Silver	ND (0.002)[2]	not available
Zinc	0.042	not available

Source: City of Santa Rosa Technical Memorandum P8.(1990), City of Petaluma (1994)

1 All units in mg/L unless noted otherwise. Period of record: 1993 - 1994 for metals and cyanide and 1985 - April 1989 for other constituents.

2 ND = concentration was below detection. Numbers in parentheses are reporting limits.

The City of Petaluma collects water quality data in the Petaluma River in compliance with Regional Board monitoring requirements. Water quality data were also collected in the Petaluma River at the Petaluma Marina near Highway 101 by the Long-Term Project Team on 18 May 1994. Petaluma River water quality data are summarized in Table 4.6-21.

Table 4.6-21

Summary of Petaluma River Water Quality

Constituent (in mg/L unless otherwise noted)	Marina 18 May 1994[1]	Station C2-A mean/SD[2]	Station C2-B mean/SD[2]
Ammonia-Nitrogen	0.21	1.16 / 0.082	1.23 / 0.850
Un-ionized Ammonia - Nitrogen		0.0045 / 0.0032	0.0051 / 0.0036
Chlorophyll	ND (0.010)	0.014 / 0.026	0.015 / 0.029
TDS	10,000	12,242/11,896	12,905 / 12,865
Dissolved Oxygen	6.3	7.1 / 1.7	7.1 / 1.7
Temperature (°C)	18.0	11.5 / 3.9	11.4 / 3.8
Nitrate-Nitrogen	0.42	NA	NA
Cadmium, total	ND (0.0005)	NA	NA
Chromium, total	ND (0.005)	NA	NA
Copper, total	ND (0.005)	NA	NA
Lead, total	ND (0.002)	NA	NA
Nickel, total	0.010	NA	NA
Silver, total	ND (0.001)	NA	NA
Zinc, total	0.040	NA	NA

Source: City of Santa Rosa Technical Memorandum P8. (1990)

ND = concentration was below detection. Numbers in parentheses are reporting limits.
NA = Not analyzed
TDS = Total Dissolved Solids

[1] Collected by HBA Team at Marina entrance near Hwy 101 bridge

[2] Station locations appear in *Draft Environmental Impact Report - Petaluma Wastewater Treatment and Storage Facilities Project,* and are described as follows: C2-A is located 500 feet upstream of Petaluma discharge. C2-B is located 500 feet downstream of Petaluma discharge. Petaluma discharge location is approximately 2 miles downstream of Hwy 101 bridge.

San Pablo Bay

Water quality in San Pablo Bay is dominated by regional factors such as the Sacramento-San Joaquin River inflow and quality. San Pablo Bay is shallow, and wind-induced turbulence suspends sediment and creates turbidity. Water quality in San Pablo Bay is measured several times each year by the San Francisco Estuary Regional Monitoring Program for Trace Substances, a cooperative program managed and administered by the San Francisco Estuary Institute. Data reported in the Program's 1993 Annual Report (SFEI, 1994) from Station BD 20 are summarized in Table 4.6-22. Station BD 20 is located centrally in San Pablo Bay where mean depth is approximately 8 feet.

Table 4.6-22

Summary of Water Quality in San Pablo Bay

Constituent (in mg/L unless otherwise noted	2 March 1993	26 May 1993	15 September 1993
Ammonia-Nitrogen	0.1	0.05	0.01
Chlorophyll *a*	0.0030	0.0035	0.0023
Dissolved Oxygen	10.00	8.30	7.20
Nitrate-Nitrogen	0.4	0.3	0.2
pH (no units)	7.8	7.6	7.8
Salinity (ppt)	6.08	16.27	25.73
Temperature (°C)	12.5	18.0	20.5
Total suspended solids	7.2	190.7	58.9
Cadmium, dissolved	0.000029	0.000068	0.000092
Chromium, dissolved	0.00022	0.00019	0.00014
Copper, dissolved	0.0025	0.0019	0.0013
Lead, dissolved	0.000021	0.000006	0.000010
Mercury, dissolved	0.0000024	0.0000012	0.0000033
Nickel, dissolved	0.0037	0.0019	0.0014
Zinc, dissolved	0.00078	0.00041	0.00046

Source: San Francisco Estuary Institute Annual Report (1994)

West County

The waterways of the West County Project area addressed in this section are shown in Figures 4.4-1a, b, and c.

The types of waterways in the West County Project area are as follows:

- **Creeks**. Creeks in each of the Americano and Stemple watersheds flow from east to west, and discharge into waterways called esteros.
- **Esteros**. The two esteros in the West county area, Estero Americano and Estero de San Antonio, can be considered tidal embayments or estuaries depending on inflow from the creek. The esteros are part of the Gulf of the Farallones National Marine sanctuary.

Creeks

Water quality in Americano Creek and Stemple Creek is affected by the quality of groundwater that discharges to the creek, inputs of water and other material, and internal physical, chemical, and biological processes. Assessments of the Stemple and Americano watershed have identified manure and livestock management as major factors affecting water quality (California Coastal Commission 1987; City of Santa Rosa 1989, 1990a, d; Gold Ridge Conservation District 1995, Marin County Resources Conservation District 1994).

Manure Management

For many years, manure has been recycled onto pastures each fall. A portion of the pasture-spread manure is transported into Americano and Stemple Creeks, then into the esteros when manure application is followed by rainfall of sufficient magnitude to cause runoff. Manure decreases the dissolved oxygen in the creeks and contributes ammonia and substantial nutrients. Dissolved oxygen is required for aquatic life, and ammonia is toxic to fish and other aquatic life as pH increases above about 7.5. Data from existing studies show that conditions of ammonia toxicity and dissolved oxygen depletion are common in Americano and Stemple creeks.

Livestock Management

Livestock are not excluded from most segments of Americano and Stemple creeks. This affects water quality in three ways. First, livestock prevent development of a riparian canopy, which shades the creek to maintain cooler water. Second, livestock trample the creek bank, which accelerates bank erosion and transport of sediment downstream. Third, livestock urinate and defecate directly in or adjacent to the creeks. One cow urinating in a small creek can cause the water quality objective for ammonia to be exceeded. Livestock tend to congregate in creekbeds during summer because the cooler, moist conditions are

attractive to them. Through the efforts of the Marin and Gold Ridge Resource Conservation Districts, land owner awareness has been raised, and remedial action is being taken.

Summary of Existing Water Quality Conditions

Water quality in the upper reaches of Americano and Stemple Creeks exhibits relatively little impact from agricultural practices in the watersheds. However, the effects of agricultural practices on creek water quality become more evident with increasing proximity to the Esteros. Table 4.6-23 summarizes water quality in the main stem of Americano and Stemple Creeks and tributary creeks.

Table 4.6-23

Summary of Water Quality In West County Creeks[1]
(mg/L unless otherwise noted)

	Americano Creek		Stemple Creek	
Constituent	**Main Stem**	**Tributaries**	**Main Stem**	**Tributaries**
Total dissolved solids	2027 / 290-75,000	270	697 / 280-1300	240
Turbidity (NTU)	20.2 / 3.1-93	-	44.4 / 6.3-260	-
Dissolved Oxygen	8.07 / 0.7-20	13.6	5.42 / 1.10-14	9.5
Nitrate-Nitrogen	1.00 / ND-8.70	0.43	0.967 / ND-3.10	ND (0.03)
Ammonia-Nitrogen	16.0 / ND-268	0.40	4.17 / ND-21	0.07
Un-ionized Ammonia-N	0.225 / ND-2.82	-	0.049 / ND-0.424	-
Dissolved Orthophosphate-P	2.99 / ND-13	0.17	1.60 / ND-3.70	0.03
Total Copper	0.0158 / ND-0.091	ND (0.005)	0.0086 / ND-0.026	ND (0.005)
Total Lead	0.010 / ND-0.1	ND (0.002)	0.0030 / ND-0.0073	ND (0.002)
Total Zinc	0.052 / ND-0.3	ND (0.01)	0.032 / ND-0.11	ND (0.01)
Planktonic Chlorophyll *a*	0.807 / 0.000017-16.8	0.00001	0.262 / 0.000029-0.987	ND (0.00001)

Source: *Environmental Conditions in West County Waterways* and *Irrigation/Storage Streams Water Quality Monitoring Results*, Merritt Smith Consulting 1996f, i

NTU = Nephelometric Turbidity Units

1 The average values and the range of observed values are summarized in each cell of the table as follows: average/minimum-maximum. When the value is below the reporting limit (ND), 1/2 of the reporting limit is used for calculations. When all data are below detection, the reporting limit is shown in parentheses. Data from the main stems were collected in 1988 through 1990. Data from the tributaries were collected in May 1995.

Esteros

Estero Americano and Estero de San Antonio are tidal embayments to which Americano Creek and Stemple Creek discharge, respectively. The esteros are each several miles long and vary in width from more than 1,000 feet to just a few feet. The depth of each estero is also variable, but three to six feet at mean tide is typical. Tidal influence extends to Middle Road in Estero Americano and to Highway 1 in Estero de San Antonio. The progressive accumulation of sediment and water quality changes are documented in several key reports including California Department of Fish and Game (1977), California Coastal Commission (1988), City of Santa Rosa (1988, 1989, 1990), and Marin County Resource Conservation District (1994). This section describes the existing water quality and hydrology conditions in the esteros and key controlling factors. The esteros are part of the Gulf of the Farallones National Marine Sanctuary and the Central California Coast Biosphere Reserve.

Sand Bar

Tidal energy in the ocean controls water movement in the esteros, and thus it also controls water quality in the esteros. Sand can accumulate in the inlet of each estero as a result of wind-induced turbulence in Bodega Bay. During spring tide conditions, ebb tide flows are typically sufficient to erode the accumulated sand. If sand accumulates during a neap tide condition, outflow may be insufficient to erode the accumulated sand, and the inlet is blocked. Sand can continue to accumulate, hydraulically isolating the esteros from Bodega Bay. The sand bar may remain until rainfall runoff accumulates in the esteros behind the sand bar, then overtops and quickly cuts through the sand bar. This process does not occur every year in the esteros. The accumulation of sediment in the esteros from watershed erosion during the past 100 years has reduced the volume of tidal water moving between Bodega Bay and the esteros, which likely results in more frequent bar closure than occurred prior to sediment accumulation. Bar closure is described in Marin County Resource Conservation District (1994).

The Estero Americano bar was maintained in an open condition during the 1980s by the owners of a fish farm near the Estero Americano inlet. Manipulation of the Americano bar by the fish farm operators no longer occurs, but both bars are occasionally opened by local land owners to relieve flooding.

Mixing and Salinity

Salinity in the esteros is influenced by the amount of freshwater inflow from the creeks, the amount of tidal inflow from Bodega Bay, and evaporation. During and after a large rainfall event, freshwater inflow can flush virtually all seawater from the esteros. As inflow decreases, seawater replaces freshwater in the estero. During summers when the bar is open and freshwater inflow is negligible,

evaporation leads to salinity levels in excess of seawater (hypersalinity). During summers when the bar is closed, salinity is determined by salinity at the time of bar closure, any continued inflow, and evaporation. Freshwater inflow can float on top of seawater, and if the bar closes during a period of stratification, wind mixing of the two layers also influences salinity. Hypersaline conditions have not been observed during bar-closed conditions, probably because freshwater was present when the bar closed and was retained in, rather than flushed from the esteros by tidal action.

Existing Water Quality Conditions

Table 4.6-24 summarizes the range of water quality conditions in each estero under bar-open and bar-closed conditions. A three-year study of the esteros (Merritt Smith Consulting 1996g) and other studies (Department of Fish and Game 1977, Marin County Resource Conservation District 1994) show how water quality in the esteros is affected by the quality and quantity of freshwater inflow, tidal inflow, and natural physical, chemical and biological processes that occur in the esteros. In addition to serving as a source of organic matter, manure is a source of nutrients and toxic ammonia. Dissolved oxygen is sometimes nearly depleted when organic matter, such as manure from the watershed and aquatic plants that grow in the estero, is oxidized by bacteria. Excessive growth of planktonic algae and aquatic plants, which are dependent upon the availability of nutrients such as nitrate and ammonia, is another important process that can contribute to oxygen depletion. Table 4.6-24 shows that dissolved oxygen is at times nearly depleted in the esteros, and that nitrate and ammonia are, at times, elevated.

The extreme dissolved oxygen and nutrient (including ammonia) conditions occur in the upper esteros, where the influence of creek flow is greatest. Nutrients and dissolved oxygen are much less variable in the lower end of each estero, because the sea moderates the influence of inflow from the watersheds. Copper has been found in Americano Creek at levels that exceed what is typically found in natural waters.

Table 4.6-24

Summary of Estero Water Quality
(mg/L unless otherwise noted)

	Estero Americano		Estero de San Antonio	
	Bar-Open[1]	Bar-Closed[2]	Bar-Open[1]	Bar-Closed[2]
Salinity (parts/thousand)	27.0 / 0-38.8		17.6 / 1.1-38	12.2 / 0.5-18.7
Turbidity (NTU)	17.6 / 1.3-120		12.7 / 2.1-51	12.3 / 2.7-52
Dissolved Oxygen	8.1 / 3-16.8		8.2 / 2.1-20	10.3 / 3.2-20
Nitrate-Nitrogen	0.37 / ND-8.7		0.31 / ND-1.2	0.27 / ND-1.5
Ammonia-Nitrogen	0.60 / ND-10		0.71 / ND-3.3	0.5 / ND-2.8
Un-ionized Ammonia-N	0.004 / ND-0.046		ND	ND
Phosphate-P	0.46 / ND-3.5		0.86 / 0.24-2	1.5 / 0.58-2.2
Copper	0.0058 / ND-0.036		0.0028 / ND-0.006	0.004 / ND-0.012
Lead	0.015 / ND-0.1		0.0005 / ND-0.0007	0.0004 / ND-0.001
Zinc	0.034 / ND-0.36		0.007 / ND-0.01	0.007 / ND-0.024
Planktonic Chlorophyll *a*	0.026 / 0.000014-0.56		0.035 / 0.00083-0.242	0.062 / 0.0039-0.169

Source: *Environmental Conditions in West County Waterways*, Merritt Smith Consulting 1996g

NTU = Nephelometric Turbidity Units

1 The average values and the range of observed values are summarized in each cell of the table as follows: average/minimum-maximum.

2 No data are yet available for bar-closed conditions in Estero Americano since the bar has not been closed when water quality data were being collected.

Geysers

The Geysers Alternative will potentially affect creeks adjacent to the pipeline alignment that extends from Delta Pond north to the geysers steamfield area, and creeks in the steamfield area. Water bodies of the geysers study area are shown in Figure 4.4-1a, b, and c.

Creeks

Water quality in the creeks of the geysers study area is influenced by several types of land use in the watersheds that drain the area. Much of the land in the area is

grazed for beef and dairy cattle. Influences to the water quality of creeks associated with livestock include runoff of manure, cattle wading in creeks, and erosion. Residential development may also affect the area. These influences are due to runoff of stormwater over paved and unpaved roads and through residential and commercial areas. In addition, septic systems may affect water quality. Water quality along the northern alignment of the pipeline (from Pine Flat Road north to the steamfield) is also potentially influenced by the natural soil geology, abandoned mine tailings and geothermal industry activities. Natural geology and mine tailings may introduce heavy metals into creeks. Geothermal industry activities may introduce pollutants from drilling and maintenance operations at wells, pump stations, and pipelines. Water quality is also influenced by water diversions that occur at three locations in Big Sulphur Creek from October through June.

The descriptions of the creeks in the geysers study area, in some cases, reflect only the section of those creeks near the alignment. Field observations were made as far upstream and downstream from the proposed pipeline crossings as feasible (Merritt Smith Consulting 1996p).

Existing Water Quality Conditions

Water quality has been sampled for three creeks:

- Big Sulphur Creek
- Cobb Creek
- Squaw Creek

Cobb Creek and Squaw Creek are tributary to Big Sulphur Creek, which drains to the Russian River. They are cold-water, high-gradient creeks with significant in-creek shelter and vegetative canopy. Their physical characteristics imply conditions of good water quality. Data collected from a two-year water quality monitoring study conducted in 1981 to 1983 for these creeks (McMillan 1985) are shown in Table 4.6-25. These data averages generally indicate good water quality in all three creeks relative to creeks with heavier urban and/or agricultural influences.

Table 4.6-25

Summary of Water Quality in Geysers Creeks

Constituent[1] (in mg/L unless otherwise noted)	Big Sulphur Creek BIS-26.2		Big Sulphur Creek BIS-16.1		Cobb Creek Co-0.1		Squaw Creek Sq-8.1	
	Range	Average[2]	Range	Average[2]	Range	Average[2]	Range	Average[2]
Alkalinity (as $CaCO_3$)	62-246	132	71-180	127	66-198	119	103-180	145
Aluminum	ND (0.020)-0.13	<0.081	0.21-0.95	0.50	ND (0.030)-0.25	<0.109	ND (0.030)-1.2	<0.500
Arsenic	ND (0.002-0.002)	ND (0.002)	ND (0.002)-0.020	<0.0039	ND (0.002)-0.011	<0.0028	ND (0.002-0.002)	ND (0.002)
Boron	ND (0.05)-1.4	<0.45	0.42-3.90	1.53	0.29-1.2	0.57	ND (0.05)-0.40	<0.26
Cadmium	ND (0.0005-0.001)	<0.00083	ND (0.0005-0.001)	<0.00083	ND (0.0005-0.001)	<0.00083	ND (0.0005-0.001)	<0.00083
Chromium	0.0015-.0002	<0.0018	0.0014-0.012	0.0055	ND (0.001)-0.002	<0.0014	ND (0.001)-0.0029	<0.0020
Chromium Hexavalent	ND (0.001-0.002)	<0.002	ND (0.001-0.002)	<0.002	ND (0.001-0.002)	<0.002	ND (0.001-0.002)	<0.002
Copper	0.003-0.0088	0.0053	ND (0.002)-0.005	<0.0033	ND (0.002-0.003)	<0.0023	ND (0.002)-0.006	<0.0037
Dissolved Oxygen	7.6-11.3	9.4	8.7-11.4	10.0	8.0-10.8	9.6	8.3-10.9	9.6
Conductivity (μmhos/cm)	150-570	300	185-660	391	148-395	250	215-345	287
Flow (cu ft/sec)	0.7-87.0	19.4	2.3-239.9	54.2	0.5-44.6	12.4	0.1-21.1	6.2
Hardness (as $CaCO_3$)	75-170	123	100-190	145	83-130	107	100-150	125
Iron	0.060-0.18	0.109	0.11-1.1	540	0.060-0.200	0.111	0.12-1.00	0.447

Table 4.6-25

Summary of Water Quality in Geysers Creeks

Constituent[1] (in mg/L unless otherwise noted)	Big Sulphur Creek BIS-26.2		Big Sulphur Creek BIS-16.1		Cobb Creek Co-0.1		Squaw Creek Sq-8.1	
	Range	Average[2]	Range	Average[2]	Range	Average[2]	Range	Average[2]
Lead	ND (0.01)-0.03	<0.017	ND (0.01)-0.014	<0.011	ND (0.01-0.01)	<0.010	ND (0.01)-0.017	<0.012
Manganese	0.01-0.025	0.017	ND (0.010)-0.050	<0.023	ND (0.01)-0.015	<0.012	0.010-0.049	0.026
Mercury	ND (0.00005-0.00005)	ND (0.00005)	ND (0.00005)-0.00034	<0.00007	ND (0.00005-0.00005)	ND (0.00005)	ND (0.00005-0.00005)	ND (0.00005)
Nickel	ND (0.010)-0.016	<0.013	ND (0.010)-0.031	<0.018	ND (0.010)-0.010	ND (0.01)	ND (0.010)-0.014	<0.012
Ammonia-Nitrogen	ND (0.0050)-0.54	<0.174	ND (0.050)-1.2	<0.505	ND (0.0050)-0.47	<0.111	0.037-0.27	<0.068
Un-ionized Ammonia (as NH_3)	ND (0.020-0.020)	ND (0.020)	ND (0.020)-0.040	<0.022	ND (0.020-0.020)	ND (0.020)	ND (0.020)-0.060	<0.024
Nitrate-nitrogen	ND (0.030)-1.10	<0.294	0.18-10.0	2.66	ND (0.030)-0.42	<0.197	0.058-0.41	<0.162
Orthophosphate	ND (0.001)-0.018	<0.0077	ND (0.001)-0.030	<0.0098	ND (0.001)-0.025	<0.013	ND (0.001)-0.037	<0.017
pH	7.7-8.4	8.0	7.9-8.6	8.1	7.8-8.1	8.0	7.9-8.3	8.0
Selenium	ND (0.002-0.002)	ND (0.002)	ND (0.002-0.002)	ND (0.002)	ND (0.002-0.002)	ND (0.002)	ND (0.002-0.002)	ND (0.002)
Sulfate	7.6-42.0	20.8	13.0-170.0	62.6	5.2-17.0	10.3	4.3-11.0	7.5

Table 4.6-25

Summary of Water Quality in Geysers Creeks

Constituent[1] (in mg/L unless otherwise noted)	Big Sulphur Creek BIS-26.2		Big Sulphur Creek BIS-16.1		Cobb Creek Co-0.1		Squaw Creek Sq-8.1	
	Range	Average[2]	Range	Average[2]	Range	Average[2]	Range	Average[2]
Suspended Solids)	1.0-16.0	<3.7	ND (2.0)-500.0	<51.1	1.0-580	<50.6	1.0-17.0	<4.1
Temperature (°C)	10.0-27.5	16.2	10.0-26.4	15.6	10.6-20.5	14.1	7.8-17.8	12.5
Total Organic Carbon	ND (1)-78	<10	ND (2)-37	<7	ND (1)-48	<8	1-14	<4
Turbidity (NTU)	0.25-4.2	1.28	1.2-310	31.3	0.20-380	32.57	0.20-18.0	2.98
Vanadium	ND (0.01-0.01)	ND (0.01)	ND (0.01-0.01)	ND (0.01)	ND (0.01-0.01)	ND (0.01)	ND (0.01-0.01)	ND (0.01)
Zinc	ND (0.005)-0.020	<0.014	ND (0.005)-0.018	<0.010	ND (0.005)-0.015	<0.010	0.005-0.023	0.013

Source: KGRA-ARM Program, 1982-1983 Annual Report, March 1985

NTU = Nephelometric Turbidity Unit

1. Data shown are for monthly samples were taken of all constituents except metals (3 times/year for metals, except monthly for mercury) from January 1982 through September 1983.
2. < used in report to indicate some of the values in the average were indeterminate

These creeks flow through the geysers steamfield and are subject to potential geothermal development impacts (e.g., water diversions, erosion, cooling tower drift, accidental spills of chemicals) and dissolution of minerals from natural deposits and abandoned mines. In addition, creek temperatures may be influenced by geothermal activity. For example, Little Geysers Creek (30°C) is a tributary to Big Sulphur Creek (13°C upstream, 18°C downstream) with the confluence just upstream of the pipeline crossing.

Estimated Water Quality Conditions

Creeks along the alignment that do not have measured water quality data are described based on knowledge of the area and the physical characteristics observed during field surveys. These 12 creeks can be divided into two general groups.

Creeks further north along the geyser pipeline alignment can be expected to exhibit relatively good water quality based on land use influences and physical characteristics. These creeks exist along Pine Flat Road and Chalk Hill Road and include:

- Anna Belcher Creek;
- Hurley Creek;
- Little Sulphur Creek;
- Unnamed Creek at Bear Canyon;
- Deer Creek;
- Maacama Creek (Chalk Hill Road); and
- Franz Creek (Chalk Hill Road).

These are clear, higher gradient, faster moving creeks with significant stretches of canopy that maintain lower water temperature. While all may be seasonal creeks, flows appear to be sufficient to maintain lower temperatures and higher dissolved oxygen. These creeks are not influenced by urban runoff (locations are remote) and can be expected to exhibit lower concentrations of the associated pollutants such as metals, oil, and grease. Land uses in the area include ranching and mining. Influences from mining appear to be minimal given the location and small size of the abandoned mines. Cattle have access to the creeks and their influence on water quality is unknown, however nutrients and suspended solids are potentially higher in those creeks.

Based on land uses and physical characteristics, creeks further south along the pipeline alignment (south of Highway 128) can be expected to exhibit poorer water quality. These creeks include:

- Sausal Creek;
- Hoot Owl Creek;
- Brooks Creek;

- Unnamed Creek tributary to Pool Creek; and
- Pool Creek.

These creeks are small, or wide and shallow, and probably all are seasonal. They have little if any canopy to maintain lower water temperatures. The substrate for these creeks is predominantly silt and sand indicating erosion upstream and lower velocities. In-stream shelter (root wads, emergent plants, boulders) for aquatic life is generally non-existent. All of these creeks appear influenced by cattle grazing. Grazing animals appear to have access to the creeks and banks are noticeably eroded in many areas. Urban influences from roads and nearby businesses and residences appear to impact water quality in these creeks as evidenced by the presence of trash, water diversions, and channelization.

Santa Rosa Creek and Mark West Creek are located along the proposed geysers pipeline alignment. These creeks were addressed in the Santa Rosa Plain/Russian River section.

Surface Water Quality Goals, Objectives, and Policies

Table 4.6-26 identifies goals, objectives, and policies which provide guidance for development in relation to surface water quality. The table also indicates which criteria in the Surface Water Quality Section are responsive to each set of policies.

Table 4.6-26

General Plan Goals, Objectives, and Policies - Surface Water Quality

Adopted Plan Document	Document Section	Document Numeric Reference	Policy	Relevant Evaluation Criteria[1]
Sonoma County General Plan	Resource Conservation Element	Policy RC-3d Policy RC-3e	Encourage the construction of wastewater disposal systems designed to reclaim and reuse treated wastewater on agricultural crops,and which minimizes discharges into natural waterways to protect water quality	1,2,4
Marin Countywide Plan	Environmental Quality Element	Policy EQ-2.31	Water qulity should be maintained or enhanced to promote the continued environmental health of natural waterway habitats	1,2,4

Table 4.6-26

General Plan Goals, Objectives, and Policies - Surface Water Quality

Adopted Plan Document	Document Section	Document Numeric Reference	Policy	Relevant Evaluation Criteria[1]
Santa Rosa General Plan	Open Space and Conservation Element	Goal OSC-6	Maintain high levels of water quality for human consumption and other life systems in the region	1,2,4
Petaluma General Plan	Community Health and Safety Element	Policy 38	Runoff-induced sedimentation and pollution resulting from new development and from agricultural areas should be reduced	1,2,4

Source: Harland Bartholomew and Associates, Inc. 1995

Notes:
1. The evaluation criteria are in Table 4.6-27.

EVALUATION CRITERIA WITH POINT OF SIGNIFICANCE

Potential surface water quality impacts of the Project are evaluated according to specific criteria to identify significant impacts. The evaluation criteria are numerous and are organized into those that relate to the following:

1. Numeric-based Criteria. Exceedence or non-attainment of numeric water quality objectives, criteria, standards, Basin Plan, or other policies for the protection of aquatic organisms, hereafter called criteria
2. Narrative-based Criteria. Exceedence or non-attainment of narrative water quality objectives, criteria, standards, Basin Plan, or other policies for the protection of aquatic organisms, hereafter called criteria
3. Special Sites. Any alteration of water quality in an Area of Special Biological Significance or National Marine Sanctuary.
4. Sediment Criteria. Exceedence or non-attainment of numeric sediment quality guidelines for the protection of benthic organisms

Details about the criteria are provided in the *Development of Evaluation Criteria for Potential Water Quality Impacts* Technical Report (Merritt Smith Consulting 1996f). A summary of the criteria is provided below and in Table 4.6-27.

Table 4.6-27 lists each of the 118 evaluation criteria for the protection of aquatic and benthic organisms for surface water and sediment quality that were identified in the

Development of Evaluation Criteria for Potential Water Quality Impacts Technical Report (Merritt Smith Consulting 1996f). These criteria are based on water quality regulations, objectives, and guidelines that have been developed by regulatory authorities to protect aquatic life. As described in the *Water Quality Impacts Analysis* Technical Report (Merritt Smith Consulting 1996r), the Project has the potential to cause the point of significance to be exceeded (which, if exceeded, will result in a determination that the effect is significant) in a total of 55 evaluation criteria. In the case of the 60 criteria, the analysis indicates no significant effects of any Project component could occur, and, therefore, these 60 criteria are not considered further in this EIR/EIS section. Three of the criteria are addressed in other sections or duplicative of other surface water quality evaluation criteria. Table 4.6-27 lists the 55 criteria for which significant effects could occur. Table 4.6-27 also lists each of the other 60 screened criteria; they appear in groups according to the rationale why significant effects will not occur. Table 4.6-27 also identifies the three criteria that are addressed in other sections of the EIR/EIS.

Table 4.6-27

Evaluation Criteria with Point of Significance - Surface Water Quality

Evaluation Criteria	As Measured by	Point of Significance		Justification[1]
		Fresh-water	Salt-water	
1. The Project may cause numeric-based criteria to be exceeded.				
Aluminum	mg/L	0.087	none	EPA criteria
Dissolved Arsenic (all valence states)	mg/L	0.19	0.036	EPA criteria
Dissolved Cadmium	mg/L	0.0012	0.0093	EPA criteria
Dissolved Chromium III	mg/L	0.21	none	EPA criterion
Dissolved Chromium VI	mg/L	0.01	0.050	EPA criteria
Dissolved Copper	mg/L	0.013[1]	0.0024	EPA criteria
Dissolved Lead	mg/L	0.003	0.0081	EPA criteria
Total Mercury[2]	mg/L	0.0013	0.0011	EPA final chronic values
Dissolved Nickel	mg/L	0.182[3]	0.0082	EPA criteria
Total Selenium	mg/L	0.005	0.071	EPA criteria
Dissolved Silver	mg/L	0.0019[3]	0.0019	EPA criteria
Dissolved Zinc	mg/L	0.121[3]	0.081	EPA criteria
Aldrin	mg/L	0.0030	0.0013	EPA criteria
BHC-gamma (Lindane)	mg/L	0.00008	0.00016	EPA and Basin Plan criteria
Chlorinated benzenes	mg/L	0.050	0.129	EPA criteria
Chloroform	mg/L	1.24	none	EPA criteria
Dichlorobenzenes	mg/L	0.763	1.97	EPA criteria
Endosulfan-beta	mg/L	0.000056	0.0000087	EPA and Basin Plan criteria
Ethylbenzene	mg/L	32.0	0.43	EPA criteria

Table 4.6-27

Evaluation Criteria with Point of Significance - Surface Water Quality

Evaluation Criteria	As Measured by	Point of Significance: Freshwater	Point of Significance: Saltwater	Justification[1]
Halomethanes (bromodichloromethane, bromoform, bromomethane, chloromethane, dibromochloromethane)	mg/L	11.0	6.4	EPA criteria
Heptachlor	mg/L	0.0000038	0.0000036	EPA and Basin Plan criteria
Tetrachloroethylene	mg/L	0.84	0.45	EPA criteria
Trichloronated ethanes	mg/L	18.0	none	EPA criteria
Toluene	mg/L	17.5	5.0	EPA criteria
Phthalate Esters	mg/L	0.008	0.0034	The freshwater criterion for phthalates is different from the number cited in *Development of Evaluation Criterion for Potential Water Quality Impacts* Technical Report (Merritt Smith Consulting 1996). *See Water Quality Impacts* Technical Report (Merritt Smith Consulting 1996) for explanation.
Total Ammonia-nitrogen - Sensitive Species Absent[5]	mg/L	0.76	0.90	EPA criteria (For Russian River only. For Laguna and Santa Rosa Creek see Waste Reduction Strategy)
Total Ammonia-nitrogen - Sensitive Species Present[5]	mg/L	0.76	0.90	EPA criteria (For Russian River only. For Laguna and Santa Rosa Creek see Waste Reduction Strategy)
Chloride	mg/L	230	none	EPA criterion
Conductivity	µmhos/cm	250, 285	none	Basin Plan criteria[6]. (Shown are the upper 50th percentile (median) monthly values for the Russian River above and below the Laguna, respectively)

Table 4.6-27

Evaluation Criteria with Point of Significance - Surface Water Quality

Evaluation Criteria	As Measured by	Point of Significance: Fresh-water	Point of Significance: Salt-water	Justification[1]
Cyanide	mg/L	0.0052/0.022[7]	0.001	EPA and Basin Plan criteria
Dissolved Oxygen	mg/L	5.0-10	5.0-10.0	Basin Plans criteria. (Values shown are the range of minimum, lower 50th and 90th percentiles for different water bodies)
Hydrogen sulfide	mg/L	0.002	0.002	EPA criteria
pH		6.5-8.5	6.5-8.5	EPA and Basin Plan criteria
Total dissolved solids	mg/L	150-170 170-200	none	Basin Plan criteria. (Values shown are the range for the upper 50th and 90th percentiles for the Russian River above and below the Laguna)
Phosphorus Elemental	-	Not evaluated for significance or range of impacts-	-	The EPA guideline for elemental phosphorus was developed to prevent toxicity and/or bioaccumulation of only the elemental form of phosphorus. Phosphorus in reclaimed water is primarily as phosphate which is not expected to be converted to elemental phosphorus under normal environmental conditions.
Acrylonitrile, antimony, beryllium, chlorine, iron, selenium, thallium, 1,1,2,2-tetrachloroethane, 1,1,1-trichloroethane, 1,1,2-trichloroethane, 1,2-dichloroethane, 1,2-diphenylhydrazine, 2,3,5,6-tetrachlorophenol, 2,4,6-tricholorphenol, 2,4-dichlorophenol, 2,4-dimethylphenol, 2-chlorophenol, benzene, benzidine, carbon tetrachloride, chloroalkyl ethers, chloro-4 methyl-3 phenol, chlordane, chlorinated	-	Not evaluated for significance or range of impacts-	-	These substances are not considered further in this document because they have been analyzed and not detected in reclaimed water, and the detection limit is less than the Federal and State aquatic life criteria. It is not expected that the Project will provide any other source of the substance.

Table 4.6-27

Evaluation Criteria with Point of Significance - Surface Water Quality

Evaluation Criteria	As Measured by	Point of Significance		Justification[1]
		Fresh-water	Salt-water	
napthalenes, dichloroethylene, dichloropropane, dichloropropene, dieldrin, dinitrotoluene, endrin, endosulfan (alpha), haloethers, heptachlor epoxide, hexachlorobutadiene, hexachlorocyclopentadiene, hexachloroethane, isophorone, methoxychlor, mirex, nitrobenzene, nitrophenol, nitrosamines, PAHs, PCB's pentachlorophenol, pentachlorinated ethanes, phenol, tetrachloroethane, tributyl tin, trichloroethylene,				
Acrolein, chlorpyrifos, demeton, guthion, malathion, parathion, toxaphene[2]	-	Not evaluated for significance or range of impacts	-	These substances have been analyzed for but not detected in reclaimed water, but the current EPA-approved method provides a detection limit that is greater than the Federal and State aquatic life criteria. Aquatic Biological Resource impacts are evaluated in Section 4.10.
Alkalinity	-	Not evaluated for significance	-	The Evaluation criterion for alkalinity (20,000 µg/L) is a minimum which is always exceeded in reclaimed water. It is not predicted that the Project alternatives will cause a decrease in alkalinity in receiving waters to below the point of significance.

Table 4.6-27

Evaluation Criteria with Point of Significance - Surface Water Quality

Evaluation Criteria	As Measured by	Point of Significance		Justification[1]
		Fresh-water	Salt-water	
Chlorophenyl 4	-	None	Not evaluated for significance or range of impacts--	Substance not analyzed for in effluent but EPA criterion (saltwater, 29.7 mg/L) is greater than the average total organic carbon in effluent (9.3 mg/L). Chlorophenyl-4 is a compound that will be detected in a total organic carbon analysis. Therefore, the concentration of chlorophenyl 4 could not exceed the point of significance.
2. The Project may cause narrative-based criteria to be exceeded				
Color	A change in apparent color lasting more than a day	0 occurrences	0 occurrences	Basin Plans narrative criterion
Floating Material	Accumulation of visible floating material, including solids, liquids, foams, film or coating, and scum	0 occurrences	0 occurrences	Basin Plans narrative criterion
Settleable Matter	mL/L	0.1 for 30-day average and 0.2 for daily maximum in Laguna plant effluent	0.1 for 30-day average and 0.2 for daily maximum in Laguna plant effluent	Basin Plans narrative criteria. Discharge permit limit used as point of significance, because the permit limit established was to protect beneficial uses.

Table 4.6-27

Evaluation Criteria with Point of Significance - Surface Water Quality

Evaluation Criteria	As Measured by	Point of Significance		Justification[1]
		Fresh-water	Salt-water	
Biostimulatory Substances - Adverse. An increase in benthic or planktonic algae.	Benthic algae biomass and planktonic algae biomass as monthly average of chlorophyll *a*	10% increase	10% increase	Basin Plans narrative criteria. 10%, established by professional judgment, for identifying impacts on creeks. Ecological impacts on benthic or planktonic algae are also addressed by the dissolved oxygen criterion.
Biostimulatory Substances - Beneficial. A decrease in benthic or planktonic algae will be considered beneficial.	Benthic algae biomass and planktonic algae biomass as monthly average of chlorophyll *a*	10 % decrease	10% decrease	10%, established by professional judgment, for identifying impacts on creeks. Ecological impacts on benthic or planktonic algae are also addressed by the dissolved oxygen criterion.
Sediment	Suspended sediment in waterways	any increase	any increase	Basin Plans narrative criterion
Salinity. The discharge to San Pablo Bay or its tributaries may cause an increase in salinity.	ppt		any increase above background	Basin Plan narrative criterion
Temperature	°F	5 °F increase in monthly average temperature	4 °F increase in monthly average temperature in estuaries	Basin Plans narrative criteria
Turbidity - Adverse	monthly average planktonic algal biomass as chlorophyll *a*	20% increase	20% increase	Basin Plans narrative criterion. 20%, established by professional judgment, to protect visual-related beneficial uses (i.e., aesthetics and fish feeding).

Table 4.6-27

Evaluation Criteria with Point of Significance - Surface Water Quality

Evaluation Criteria	As Measured by	Point of Significance		Justification[1]
		Fresh-water	Salt-water	
Turbidity - Beneficial	monthly average planktonic algal biomass as chlorophyll *a*	20% decrease		20%, established by professional judgment, to protect visual-related beneficial uses (i.e., aesthetics and fish feeding).
Waste Reduction Strategy - Adverse a) Discharge to the Laguna may increase the concentration of ammonia. Discharge to the Laguna may cause ammonia-nitrogen load to the Laguna not to be reduced by 21,500 pounds per year	Pounds ammonia-nitrogen/year	a) If ammonia-nitrogen load in the Laguna is not reduced by 21,500 pounds per year.		This criterion applies only to the Laguna a) The North Coast Regional Water Quality Control Board Waste Reduction Strategy establishes an ammonia-nitrogen load reduction goal of 21,500 pounds per year for the Subregional System (see Table 4 in North Coast Regional Board 1995) The waste reduction strategy for ammonia was developed to bring the Laguna into attainment with EPA and Basin Plan ammonia water quality objective.
b) Discharge to the Laguna may cause total nitrogen load to the Laguna not to be reduced by 159,000 pounds per year	Pounds total nitrogen/year	b) If total nitrogen load in the Laguna is not reduced by 159,000 pounds per year.		b) The North Coast Regional Board Waste Reduction Strategy establishes a total nitrogen reduction goal of 159,000 pounds per year for the Subregional System (see Table 4 in North Coast Regional Board 1995).is the basis for the adverse impact criterion and point of significance.

Table 4.6-27

Evaluation Criteria with Point of Significance - Surface Water Quality

Evaluation Criteria	As Measured by	Point of Significance: Fresh-water	Point of Significance: Salt-water	Justification[1]
Waste Reduction Strategy - Beneficial	a) Pounds ammonia-nitrogen/year b) Pounds total nitrogen/year	a) If ammonia-nitrogen is reduced by more than 21,500 pounds per year b) If total nitrogen is reduced by more than 159,000 pounds per year		a)Exceeding the Waste Reduction Strategy goal for ammonia-nitrogen is the basis for the beneficial impact criterion . b) Exceeding the Waste Reduction Strategy goal for total nitrogen is the basis for the beneficial impact criterion
Toxicity (lethal effects)	frequency of toxic conditions	any increase	any increase	Basin Plan Criterion
Pesticides (see Aquatic Biological Resources Section 4.9) Suspended matter (addressed above with sediment and biostimulatory substances) Oil and grease (addressed above with floating material)				
3. Special site criteria				
The Project may cause water quality change to occur in the Area of Special Biological Significance or in the Sanctuary.		Any change	Any change	Special Site Criteria
4. The Project may cause sediment quality evaluation criteria to be exceeded.				
Acenaphthene	μg/g organic carbon	130	230	EPA criteria
Dieldrin	μg/g organic carbon	11	20	EPA criteria
Endrin	μg/g organic carbon	4.2	0.76	EPA criteria

Table 4.6-27

Evaluation Criteria with Point of Significance - Surface Water Quality

Evaluation Criteria	As Measured by	Point of Significance: Fresh-water	Point of Significance: Salt-water	Justification[1]
Fluoranthene	μg/g organic carbon	620	300	EPA criteria
Phenanthrene	μg/g organic carbon	180	240	EPA criteria

Source: *Development of Evaluation Criteria for Potential Water Quality Impacts*, Merritt Smith Consulting 1996f

1 Two types of justification are provided in this column: justification for further consideration and justification for no further consideration. For substances that are considered further, the justification column contains the source of the criteria that are potentially exceeded as a result of component implementation. For substances that are not considered further, the justification column states why they are not further considered.

2 EPA Final Chronic Values used because EPA criteria are based on the FDA action level for human consumption of fish. The EPA is uncertain whether the Final Chronic Values are completely protective of all fish species

3 Criteria of significance are hardness dependent. Value shown is for a hardness of 119 (average hardness of the Russian River).

4 EPA concluded that the available data on freshwater acute-chronic ratios do not allow calculation of a freshwater Final Chronic Value, but if one could be calculated it will have to be less than the 0.039 μg/L that adversely affected brook trout.

5 Criteria are temperature and pH dependent. Values shown are for 20°C and pH = 8 which reflect the long-term averages in the lower Russian River (Merritt Smith Consulting 1996n)

6 Basin Plan also has a 90th percentile criterion for conductivity which is based on all values for a calendar year. The 50th percentile upper limit point of significance for conductivity is more stringent than the 90th percentile upper limit point of significance. Therefore, compliance with the 50th percentile upper limit point of significance was evaluated.

7 EPA has established criteria to protect aquatic life against short- and long-term cyanide exposure (22 and 5.2 μg/L, respectively). 5.2 μg/L is used in this analysis to evaluate the significance of effects of component that result in long-term exposure (i.e., discharge) and 22 μg/L is used to evaluate the significance of effects of component that result in short-term exposure (i.e., pipeline rupture).

Numeric Water Quality Objectives

EPA and the Regional Boards have established numeric water quality standards, guidelines, objectives, and policies to protect aquatic life and human health. Potential human health impacts of water quality are addressed in Section 4.7 of the EIR/EIS. Typically, the water quality objectives for the protection of aquatic life were developed by EPA to protect the environment against toxicity (adverse physiological effect) and bioaccumulation (accumulation of pollutants in organisms). There are generally two numeric criteria for a given substance: one that protects aquatic life when exposed to the substance for a short time period (criterion maximum concentration or CMC) and one that protects aquatic life when exposed to the substance for a longer time period (criterion continuous concentration or CCC).

Neither the reclaimed water nor the potential receiving water exceeded any CMC for which data are available. Therefore, the points of significance for each evaluation criterion and impacts are based on CCCs. Use of the CCCs for evaluation criteria is conservative since the CCCs are usually much more stringent than the CMCs. The evaluation of impacts relative to the CCCs is described in the *Water Quality Impacts Analysis* Technical Report (Merritt Smith Consulting 1996r).

Applicable numeric water quality objectives for the protection of aquatic life are described in Table 1 of the *Development of Evaluation Criteria for Potential Water Quality Impacts* Technical Report (Merritt Smith Consulting 1996f).

A potential water quality impact is considered significant and adverse if applicable numeric water quality criteria will be exceeded as a result of the Project, or if a water quality criterion is currently being exceeded and implementation of the Project will increase the magnitude of the exceedence.

Narrative Water Quality Objectives

Narrative objectives have been established by the Regional Boards to protect beneficial uses and thus apply to receiving waters. The narrative objectives have been used as a basis for evaluation criteria. For example the North Coast Regional Board's narrative objective for floating material is:

> Waters shall not contain floating material, including solids, liquids, foams, and scum in concentrations that cause nuisance or adversely affect beneficial uses.

The corresponding evaluation criterion used in this section is:

> The Project may cause floating material, including solids, liquids, foams, and scum in concentrations that cause nuisance or adversely affect beneficial uses.

The majority of the narrative-based criteria are established to evaluate for adverse impacts. Evaluation criteria to evaluate for potential beneficial impacts have been established for Biostimulatory Substances, Turbidity and Waste Reduction Strategy. Each

of the narrative-based criteria is described in the *Development of Evaluation Criteria for Potential Water Quality Impacts* Technical Report, (Merritt Smith Consulting 1996f).

Special Sites Criteria

The Management Plan of the Gulf of the Farallones National Marine Sanctuary and the regulations (15 CFR 936) indicate that the Sanctuary was created to protect an unusual site. The policy of the Bay Regional Board regarding the State-designated Area of Special Biological Significance at Tomales Point is that no Project shall affect water quality in the Area. Therefore, a higher standard is applied to water quality impacts potentially affecting these resources. Any water quality change in the Area of Special Biological Significance or in the Sanctuary is considered significant.

Sediment Criteria

The EPA has proposed sediment quality criteria under Section 304(a) of the Clean Water Act for the following five nonionic organic chemicals: acenaphthene, dieldrin, endrin, fluoranthene, and phenanthrene. The proposed sediment quality criteria have been used to develop Project evaluation criteria.

METHODOLOGY

Surface water quality impacts were evaluated based on water quality data that characterize the receiving water environment and reclaimed water. The approach used to evaluate potential impacts from Project components that potentially affect surface water quality is described below.

Potential impacts for three components (headworks expansion, pump stations, and geysers steamfield) are not addressed in detail throughout the following section, because they will not affect surface water quality. No methodology is presented for analysis of these components.

Urban Irrigation

Section 2.2 of this EIR/EIS and the *Urban Irrigation Management Guidelines* Technical Report describe conditions under which urban irrigation will occur (Questa Engineering Corporation, Inc. 1996d). The potential for effects on surface water was evaluated based on the Project description and an assessment of potential impacts was made.

Pipelines

Potential impacts of pipeline construction and rupture on water quality were evaluated by inspecting each location where a pipeline will cross a distinct waterway. Waterways were evaluated for substrate type (which relates to erosion and sediment transport potential) and other characteristics that were used to evaluate for potential aquatic life impacts (e.g., vegetation, in-stream shelter). The results of the creek crossing surveys are reported in the *Stream Crossings Assessment* Technical Report (Merritt Smith Consulting 1996p).

Potential impacts of a pipeline rupture on water quality related to numeric criteria were evaluated by comparing undiluted reclaimed water to the appropriate numeric criteria, assuming no dilution of reclaimed water by ambient water. Due to the short duration of exposure from a pipeline rupture, the acute EPA guidelines (one hour) were used to evaluate for potential impacts. Potential impacts from pipeline construction related to narrative criteria were evaluated by considering the type of construction (jack and bore or open trench) at each crossing.

Storage Reservoirs

Storage reservoirs potentially affect surface waters by seepage of reclaimed water through soil, discharge via the spillway due to rainfall runoff, and dam failure. Seepage impacts were evaluated for each storage site by estimating the mixing of reservoir seepage with groundwater and using the groundwater and effluent quality data. This method is described in the *Water Quality and Flow Model for Irrigation/Storage Area Streams* Technical Report (Resource Management Associates 1996a).

The quality of reclaimed water that may seep from reservoirs is not necessarily the same as that described in Table 4.6-1, since biological activity in a thermally stratified storage reservoir affects reclaimed water quality. In particular, dissolved oxygen can depleted, nitrate can be converted to ammonia, and sulfur compounds can be converted to hydrogen sulfide in the bottom layer of a thermally stratified reservoir. Thermal stratification can exist from mid-spring through summer. For purposes of the surface water quality impacts analysis, maximum ammonia and hydrogen sulfide formation was assumed because ammonia is of more concern for aquatic biota than nitrate. The groundwater impacts evaluation assumed that nitrate levels in reclaimed water are not reduced by conversion to ammonia, because drinking water standards for nitrate are the primary concern for groundwater.

Agricultural Irrigation

Agricultural irrigation potentially affects surface waters through subsurface seepage with subsequent discharge (subflow). Subflow quantity and quality were characterized by estimating the mixing of irrigation-related flow and groundwater using the groundwater and effluent quality data. This method is described in the following Technical Reports:

- *Estimation of Nitrogen, Salts, Pesticides in Surface Waters* (Questa Engineering Corporation, Inc. 1996c)
- *Baseline Hydrology and Irrigation Drainage Evaluation for West and South County Reclamation Alternatives* (Questa Engineering Corporation, Inc. 1996b)
- *Estimation of Metals Concentrations in Surface and Groundwater* (Questa Engineering Corporation, Inc. 1996a)
- *Water Quality and Flow Model for Irrigation/Storage Area Streams* (Resource Management Associates 1996a)

Information about background surface and groundwater flow rates and quality, reservoir seepage rate and quality, irrigation subflow rate and quality was input to a model that was established for each watershed. The model was developed to estimate flow and water quality at key locations in the watersheds. Average flow and quality at each location was estimated for each storage option in the watershed (e.g., for Stemple watershed the storage options are Two Rock, Huntley, and no storage). The flow and quality impacts were estimated as average spring and summer conditions. The effect on surface water of irrigating lands located outside of the Tolay watershed and outside of Bay Flats area was evaluated in the *Baseline Hydrology and Irrigation Drainage Evaluation for West and South County Reclamation Alternative* (Questa Engineering Corporation, Inc. 1996b).

Bay Flats were addressed separately from other Project areas because the soils and drainage characteristics of Bay Flats soils are fundamentally different from other Project areas. Project irrigation drainage from the bay flats area will be pumped into the Petaluma River Estuary during the fall/winter season, as managed by Novato Sanitation District. This management approach and potential effects of irrigation of Bay Flats areas on surface water quality are described in *Hydrologic/Water Quality Evaluation of Irrigation of Baylands (Reyes Soils) with Reclaimed Water*, (Questa Engineering Corporation, Inc. 1996e) and *Water Quality Impact Analysis* Technical Report (Merritt Smith Consulting 1996r).

Discharge

Several different methods were used to evaluate the impacts of discharge. Impacts on water quality constituents affected by biological activity were estimated with a water quality simulation model; impacts on conservative constituents were estimated with a dilution model; impacts on waste load reduction were evaluated with a nutrient load model, and impacts on sediment quality were estimated with a partition coefficient model. These methods of impact evaluation are described in the following sections.

Constituents Affected by Biological Activity - Water Quality Simulation Model

The potential impacts of design and contingency discharge on biologically reactive constituents in the Laguna de Santa Rosa and the Russian River were evaluated using a hydraulic and water quality model (Resource Management Associates 1996b). This model was developed from the earlier adaptation of EPA's QUAL2e model by the North Coast Regional Board. North Coast Regional Board staff and other interested parties provided input to establish needs for further model refinement. The model simulates reclaimed water dilution, uptake of nutrients by planktonic and benthic algae, growth of planktonic and benthic algae, dissolved oxygen, ammonia, and temperature with different discharge scenarios.

Design discharge scenarios are described in Table 4.6-28.

Table 4.6-28

Design Discharge Scenarios

Discharge Scenarios	Receiving Water	Alternative
Discharge associated with the No Action Alternative	Laguna	Alt 1
1% design discharge	Laguna	Alt 2, Alt 3
Discharge associated with the Geysers Alternative	Laguna	Alt 4
20% design discharge	Russian River (with a small fraction discharging to the Laguna)	Alt 5A
20% design discharge	Laguna	Alt 5B

Source: Merritt Smith Consulting

Discharge scenarios are named in the above table based on the maximum design monthly average discharge rate (e.g., 20%) expressed as a percentage of Russian River flow at Hacienda Bridge. The median discharge rate is considerably less than the maximum. For example, the median discharge rate for the 1 and 20% design discharge components is 0 and 3%, respectively.

Contingency discharge is defined as the discharge of reclaimed water in excess of the design discharge rate after the education-conservation and winter irrigation contingency programs have been implemented. Contingency discharge is associated only with the 20% design discharge scenarios (River and Laguna). The *Water Balance Contingency Plan* Technical Report (Parsons Engineering Science, Inc. 1996b) shows that the 1% design discharge alternatives do not include contingency discharge. By definition, the No Action and geysers alternatives do not have contingency discharge phases.

Design Discharge

The model was run to simulate conditions for a very dry year, a very wet year, and a normal year as defined over the past 70 years of Russian River flow data available. The actual years were chosen to represent these conditions. Estimated hourly streamflows were used to represent the extreme and normal flows.

Table 4.6-29

Russian River Flows

Condition	Russian River Flows	Year
Very Dry	10th percentile	1976
Normal	50th percentile	1961
Very Wet	90th percentile	1982

The 10th percentile water year (1976) is the year in which total annual Russian River flow was less than 90% of the total annual Russian River flow values during the period of record (see Surface Hydrology section). Operations of the Subregional System, including reclaimed water design discharge, for each of the design discharge components cited above in this paragraph were based on the *Water Balance Contingency Plan* Technical Reports (Parsons Engineering Science, Inc. 1996b). Daily flow estimates for 1976, 1961, and 1982 are based on actual River flow measurements that were adjusted to reflect future diversions, consistent with the method described in the *Water Balance Contingency Plan* Technical Report (Parsons Engineering Science, Inc. 1996b).

The model simulates reclaimed water dilution, uptake of nutrients by planktonic and benthic algae, growth of planktonic and benthic algae, dissolved oxygen, temperature, and other water quality characteristics using an hourly time step. From this information, the model estimates the mean, minimum, and maximum monthly biomass of benthic and planktonic algae, temperature, dissolved oxygen concentrations, and ammonia concentrations at locations in Santa Rosa Creek, the Laguna de Santa Rosa, and the Russian River for each of the three hydrologic years. These estimates are made for baseline conditions (without design discharge) and with design discharge.

The model simulates fundamental relationships between physical (e.g., temperature, sunlight, and flow) and chemical conditions (e.g., nutrient concentrations and dissolved oxygen), and algae growth. Like most water quality models, QUAL2E was originally developed so that the rate at which various phenomena occur (e.g., flux of nutrients from sediment and nutrient uptake rate) can be adjusted to most closely represent conditions in the waterway that is the subject of the simulation. The process of fine-tuning the model to represent local conditions is called calibration.

The Laguna/Russian River model application was calibrated against measured water quality conditions in three years (fall 1992 through summer 1995). The calibration process and the comparison of estimated to observed water quality values are presented in the *Russian River Water Quality Model* Technical Report (Resource Management Associates 1996b). The calibration is considered to be very good in that the estimated water quality trends follow those of the observed values. Models are necessarily simplifications of natural systems; therefore, the model does not perfectly duplicate observed conditions. The model is a tool to evaluate the potential range of impacts of Project alternatives for which no other means of impact assessment is suitable. For example, discharge at a design rate of 20% for purposes of evaluating Project impacts is not possible because the Subregional System does not yet have sufficient flow to implement the design discharge alternative nor a discharge permit allowing them to do so.

The model output (estimated water quality conditions) is used consistent with the expected precision based on the model calibration and other model applications. Model output that is used to evaluate potential Project impacts is integrated over space and time to provide a robust indicator of water quality. The model is considered to be sufficiently precise to show differences in estimated algae biomass of 10% (which is the point of significance for the evaluation criterion for biostimulatory substances). The model is insufficiently precise to conclude that model-predicted differences in dissolved oxygen and ammonia nitrogen of less than 0.5 mg/L will actually occur. Therefore, a predicted impact on dissolved oxygen and ammonia nitrogen of less than 0.5 mg/L was considered insignificant due to insufficient model precision.

Two water quality baseline conditions were simulated using the model: existing condition and no (zero) discharge. The impact of the existing (1994) Subregional System discharge on dissolved oxygen, ammonia, algae, and temperature was estimated for each of the three hydrologic years (dry, normal, and wet). The water quality impacts of this existing condition baseline were compared to the estimated impacts of each design discharge scenario, which provided the basis for evaluating the significance of impacts of each proposed design discharge scenarios. Potential Project impacts are compared to the no discharge baseline in the *Water Quality Impacts Analysis* technical report (Merritt Smith Consulting 1996r), and not considered further in this EIR/EIS section.

Estimates of dissolved oxygen, ammonia, algae, turbidity, and temperature impacts were developed and used as follows:

- **Dissolved oxygen.** In each of the three simulation years (1976, 1961, and 1982), the monthly average dissolved oxygen concentration was calculated in the following locations:
  - The reach of Santa Rosa Creek between Delta Pond discharge and the Laguna,

- The Laguna between Santa Rosa Creek and the Russian River,
- The Russian River between the proposed discharge location above the Wohler intakes and the Laguna (SCWA reach),
- The Russian River between the Laguna and a point seven miles downstream (Hacienda reach), and
- The Russian River in the seven-mile reach below the Hacienda reach (Guerneville reach).

Table 3-1 of the North Coast Regional Board Basin Plan states that the 50th and 90th percentile objectives of 10 and 7.5 mg/L (which apply to the Laguna and Russian River) are being attained if 50 and 90% of the monthly averages are equal to or greater than the respective objectives (10 and 7.5 mg/L). The Regional Board has also established a minimum dissolved oxygen objective of 7.0 mg/L; thus if any value in the Laguna or Russian River is less than 7.0 mg/L then the water is not in attainment. The monthly average dissolved oxygen values estimated by the model were calculated in each reach to determine attainment of the objectives under the existing condition baseline and under each design discharge scenario. If the minimum, the 50th, or the 90th percentile objective was not in attainment under the existing condition baseline, then any decrease in monthly average dissolved oxygen was considered significant. If each of the dissolved oxygen objectives was attained under the existing condition baseline but the design discharge alternative caused nonattainment of the minimum, the 50th, or the 90th percentile objective, then the impact was considered significant. Model-predicted changes in dissolved oxygen of less than 0.5 mg/L were not considered significant due to model uncertainty.

- **Ammonia**. There are two ammonia criteria: a numeric criterion for protection of aquatic organisms from potential toxic effects, and a narrative criterion for ammonia load reduction. The numeric criterion applies to the Russian River and the narrative criterion applies to the Laguna and Santa Rosa Creek. Model estimates of the monthly maximum total ammonia were made for the Russian River creek reaches defined above; estimates were made for dry, normal, and wet conditions. The numeric ammonia criterion is temperature and pH dependent. To evaluate for significant impacts in the Russian River with respect to the numeric-based ammonia criterion, the monthly maximum total ammonia was compared to the criterion for the long-term average temperature and pH of the lower Russian River. Average temperatures and average pH values were obtained from data reported in the *Russian River Water Quality Monitoring Results* Technical Report (Merritt Smith Consulting 1996n). The approach used for evaluating for ammonia waste load changes (which applies only to the Laguna de Santa Rosa and Santa Rosa Creek) is described below.

- **Algae.** The monthly average algae biomass (mass per area) and plankton density (mass per water volume) were calculated by averaging all of the estimates for a

particular location within a reach during the month and all the locations with a reach. Thus, the monthly average is a temporally- and spatially-averaged value.

- **Turbidity.** Turbidity in the Laguna and Russian River results from the presence of suspended sediment and algae. Suspended sediment can be derived from high storm flows and from resuspension of sediment in the river bottom. The potential impact of reclaimed water design discharge on suspended sediment is addressed in the Surface Water Hydrology section. Turbidity due to planktonic algae that results from reclaimed water design discharge was estimated using the water quality model by assuming a direct relationship of planktonic algae density to turbidity.

- **Temperature**. Average monthly temperatures were calculated in each of the reaches defined above and compared to the point of significance for temperature.

Contingency Discharge

The Daily Water Balance Model indicates that the contingency discharge is expected under only Alternatives 5A and 5B (Laguna and River Discharge alternatives). However, continuous discharge will not occur in any of the three hydrologic years in which design discharge impacts were evaluated using the Daily Water Balance Model. Therefore, the Daily Water Balance Model and water quality model was run using hydrologic conditions that will cause the contingency discharge phase to be implemented. Hydrologic data from 1977 (driest year on record) were found to produce contingency discharges of a volume and discharge rate that are considered typical of contingency discharges (Resource Management Associates 1996b), and so the water quality model was run using 1977 hydrologic conditions. Otherwise, the impacts evaluation approach was similar to that described above for design discharges. Using the daily operations simulation model, contingency discharge was estimated to occur in January, February, and April of 1977 for the Laguna and River Discharge alternatives (Alternatives 5A and 5B). Water quality impacts of contingency discharge were evaluated these three months only.

Conservative Constituents - Dilution Model

The concentration of most constituents in reclaimed water was assumed, for the purposes of water quality impacts evaluation, to be affected only by; and such constituents are considered to be conservative. Thus the effect on water quality was estimated by calculating the final concentration in the receiving water using a dilution calculation. Impacts of the proposed design discharge scenarios on constituents identified in the list of numeric-based criteria in Table 4.6-27 (except dissolved oxygen and ammonia) were evaluated using the following:

- The reclaimed water dilution estimates of the model

- Background water quality data described in the *Russian River Water Quality Monitoring Results* and the *Laguna de Santa Rosa Water Quality Monitoring Results* Technical Reports (Merritt Smith Consulting 1996j and n); and
- Effluent quality data described in the *Reclaimed Water Quality* Technical Report (Merritt Smith Consulting 1996k and l).

Impacts of the design discharge that were evaluated using the numeric-based evaluation criteria were evaluated using the 95th percentile reclaimed water concentration for the water year that contained the highest reclaimed water concentration (usually the driest year). The 95th percentile reclaimed water concentration is the daily average concentration that is estimated to be greater than 95% of all daily average values at a location in the particular water year. Thus, the evaluation of water quality impacts for significance was done under nearly worst-case conditions. In addition, the estimates are made based on existing conditions which already contains reclaimed water. Therefore, this approach is conservative.

Waste Load Reduction

The Regional Board has established a goal for the Subregional System to reduce the annual ammonia-nitrogen load to the Laguna system by 21,500 pounds per year from their 1994 estimated annual load of 56,600 pounds per year. The Regional Board has also established a goal for the Subregional System to reduce the annual total nitrogen load to the Laguna system by 159,000 pounds per year from their 1994 estimated annual load of 424,700 pounds per year. The ammonia-nitrogen and total nitrogen loads to the Laguna were estimated for each discharge scenario using a dilution model (calculated using the average annual design discharge to the Laguna multiplied by the expected concentration of total nitrogen, organic nitrogen, and ammonia-nitrogen in reclaimed water [14 mg /L, 2 mg/L, and 1 mg/L, respectively]). The estimated ammonia-nitrogen and total nitrogen loads to the Laguna for each discharge scenario were compared with the current total nitrogen and ammonia loads to the Laguna. If the load reduction did not meet or exceed the Regional Board's goal, the impact was considered to be adverse. If the load reduction exceeded the Regional Board's goal, the impact was considered to be beneficial.

Other Narrative Criteria

Impacts of the proposed design discharge scenario on the constituents addressed with the discharge-applicable narrative-based criteria for color, floating material, and settleable matter were evaluated using historical information about the occurrence of impacts from reclaimed water design discharges.

Sediment Quality Criteria

The potential impacts of design discharge on sediment in the Laguna de Santa Rosa and the Russian River were evaluated using a partition coefficient model. Using reclaimed water quality and Laguna and River background quality, the sediment concentrations were predicted for the five compounds for which sediment quality criteria exist. Details of the model are summarized in the *Sediment Quality Characterization for the Russian River, Laguna de Santa Rosa, Santa Rosa Creek, and Reclaimed Water Storage Ponds* Technical Report, (Merritt Smith Consulting 1996o).

ENVIRONMENTAL CONSEQUENCES (IMPACTS) AND RECOMMENDED MITIGATION

Potential impacts are evaluated for the four types of surface water quality criteria: numeric-based evaluation criteria, narrative-based evaluation criteria, impacts on special sites, and sediment criteria. Each impact identified as "significant" is described in this section. In contrast to other *Environmental Consequences (Impacts) and Recommended Mitigation* sections in this EIR/EIS, each less-than-significant impact and its associated criterion is not listed. The authors concluded that a listing of each of the large number of evaluation criteria (55) under each Project component will create a section of impractical length. However, the impact of each component on each criterion has been analyzed and is available in the *Water Quality Impacts Analysis* Technical Report (Merritt Smith Consulting 1996r).

The presentation of the potential impacts is organized differently than other parts of Section 4 in response to the complexity of the analysis as follows:

- A narrative description of the Project impacts is provided to help the reader identify impacts that are considered significant according to the evaluation criteria. A description of the impacts that are considered less than significant is provided in the *Water Quality Impacts Analysis* technical report (Merritt Smith Consulting 1996r).
- Only significant impacts are identified throughout Section 4.6 due to the large number of evaluation criteria. However, less-than-significant impacts in the component impact tables, are identified in cases where a significant impact on a particular constituent will result from another discharge scenario.
- A summary of Project and cumulative impacts is provided.

No Action (No Project) Alternative

Impact: 6.1.1-4. Will the No Action Alternative impact water quality based on evaluation criteria 1 through 4?

Analysis: *Significant; Alternative 1.*

Except for the continued discharge associated with the No Action Alternative, there will be no impact on water quality. Discharge will cause significant impacts and these are described in the discharge section below. To facilitate comparison with the effects of other discharge options, impacts of the discharge component of the No Action Alternative are reported in the Discharge section below.

Mitigation: No mitigation is proposed.

Headworks Expansion Component

Impact: 6.2.1-4. Will the headworks expansion component impact water quality based on evaluation criteria 1 through 4?

Analysis: *No Impact; All Alternatives.*

The proposed pumps are inside a building and therefore will not affect surface water quality.

Alternative 1 does not have a headworks expansion component.

Mitigation: No mitigation is needed.

Urban Irrigation Component

Impact: 6.3.1-4. Will the urban irrigation component impact water quality based on evaluation criteria 1 through 4?

Analysis: *No Impact; All Alternatives.*

Urban irrigation will be conducted on lands that are currently being irrigated, and irrigation practices on these lands are such that irrigation supply is not now reaching surface waters (Questa Engineering 1996e). Measures adopted as part of the Project (see Section 2.2.1 to 2.2.7) preclude management changes upon conversion to reclaimed water for irrigation supply, without additional environmental review. Thus, adding urban irrigation land will be expected to have no impact on surface water quality.

Alternatives 1, 4, and 5 do not have an urban irrigation component.

Mitigation: No further mitigation is needed.

Pipeline Component

Pipelines cause impacts in the following ways:

- Construction. Pipeline construction techniques (both jack and bore, and open trench) have the potential to disturb soil in waterways and exceed the suspended sediment criterion. However, implementation of erosion control practices (refer to Measures 2.2.5, Avoid Sensitive Biological Resources and 2.2.10, Storm Water

Pollution Prevention Plan, adopted as part of the Project) and the temporary effects associated with construction result in less than significant impacts.

- Ruptures. Pipeline ruptures have the potential to exceed water quality criteria with the introduction of reclaimed water into waterways. An acute (short-term) criterion is applicable due to the limited exposure to reclaimed water from a rupture. Since the acute criteria are not exceeded in reclaimed water, this impact is considered less than significant.

Table 4.6-30

Surface Water Quality Impacts by Component - Pipelines

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
6.4.1. Will the pipeline component cause numeric-based criteria to be exceeded?				
All numeric criteria	Varies	No exceedence	C, O&M	❍
6.4.2. Will the pipeline component cause narrative-based criteria to be exceeded?				
All narrative criteria	Varies	No exceedence	C, O&M	❍
6.4.3. Will the pipeline component impact special sites?				
• The Project may cause water quality changes to occur in an Area of Special Biological Significance or in the Sanctuary.	Any water quality change	No change	C, O&M	==
6.4.4. Will the pipeline component cause sediment quality evaluation criteria to be exceeded?				
All sediment criteria	Varies	No exceedence	C, O&M	❍

Source: *Water Quality Impacts Analysis*, Merritt Smith Consulting 1996r

Notes: [1] Type of Impact:
C Construction
O&M Operation and Maintenance

[2] Level of Significance codes:
❍ Less than significant impact; no mitigation proposed

Impact: **6.4.1. Will the pipeline component cause numeric-based criteria to be exceeded?**

Analysis: *Less than Significant; Alternatives 2, 3, 4, and 5A.*

Measures adopted by the City as part of the Project insure that pipeline component construction will occur such that impacts are less than significant. These measures are as follows:

2.2.5. Avoid Sensitive Biological Resources.

2.2.10 Storm Water Pollution Prevention Plan.

2.2.11. Protect Creeks from Toxic Discharge.

2.2.12. Concrete Waste Management.

As described in Measure 2.2.5, two methods will be used for constructing pipelines across streams: jack and bore and open trench. Jack and bore will not disturb the streambed and will therefore not affect water quality. The open trench method will only be used in dry streambeds, and surface sediment will be preserved during construction and replaced. This procedure will prevent introduction of fine sediment (clay and silt) that can adversely affect water quality and aquatic habitat. Thus, the streambed will be restored so that, when flow occurs at the site, sediment overlying the trench will be no different than that prior to construction, and any water quality effect will be minor and short-lived (Merritt Smith Consulting 1996r). Therefore, this impact is considered less than significant.

Pipeline rupture events (described in Section 3.4) will result in the introduction of reclaimed water into local waterways for a short period (hours). Acute (short-term) criteria are applicable due to the short duration of exposure to reclaimed water from a rupture. Numeric-based evaluation criteria will not be exceeded by surface water quality impacts related to pipelines. Since the acute criteria are not exceeded in reclaimed water, this impact is considered less than significant (Merritt Smith Consulting 1996r).

No Impact; Alternatives 1 and 5B.

These alternatives do not have a pipeline component.

Mitigation: No further mitigation is proposed.

Impact: **6.4.2. Will the pipeline component cause narrative-based criteria to be exceeded?**

Analysis: *Less than Significant; Alternatives 2, 3, 4, and 5A.*

See analysis of impact 6.4.1 above.

Pipeline ruptures could cause a short-term (hours) localized water quality impact due to turbidity that results from erosion (Merritt Smith Consulting 1996r). This impact is considered to be less than significant under the narrative-based evaluation criteria due to the short duration of the impact.

No Impact; Alternatives 1 and 5B.

These alternatives do not have a pipeline component.

Mitigation: No mitigation is proposed.

Impact: 6.4.3. Will the pipeline component impact special sites?

Analysis: *No Impact; All Alternatives.*

Pipeline construction will occur in the Stemple and Americano watersheds, which are tributary to the Gulf of the Farallones National Marine Sanctuary (a special site). Several pipelines will cross waterways that are very near or within the Sanctuary (i.e., Americano Creek at Marsh Road, Estero Americano at Franklin School Road, and Ebabias Creek at Highway 1). Construction impacts at these sites would not affect water quality because the pipeline will be constructed using the jack and bore method or the pipeline will be attached to an existing bridge.

For alternatives 2 and 4, there are no special sites in watersheds affected by these alternatives. Alternatives 1 and 5B do not have a pipeline component.

Mitigation: No mitigation is needed.

Impact: 6.4.4. Will the pipeline component cause sediment quality criteria to be exceeded?

Analysis: *Less than Significant; Alternatives 2, 3, 4, and 5A.*

Sediment quality criteria will not be exceeded due to pipeline construction because sediment quality will not be affected. Pipeline rupture will not cause sediment quality criteria to be exceeded (based on the analysis of continuous reclaimed water discharge impacts on sediment quality described below in the Discharge section).

No Impact; Alternatives 1 and 5B.

These alternatives do not have a pipeline component.

Mitigation: No mitigation is proposed.

Storage Reservoir Component

Storage reservoirs impact surface water quality in the following ways:

- Seepage of stored reclaimed water through the dam and through the bottom of the reservoir. The seepage may go into the ground and then discharge into the creek at the base of the dam. The seepage may be anoxic (without any dissolved oxygen) because the reservoir will stratify during part of the year. Influence on surface water quality from dam seepage will be limited to a short section of creek immediately below the dam sites, but will be a significant impact.

- Discharge from spillways. Spillways are intended to provide for emergency release of water only in the event of watershed runoff from a severe storm or series of storms entering the reservoir when it is full. Spillway discharge (spill) are not expected to occur. If a spill does occur, reclaimed water may impact ammonia, dissolved oxygen, biostimulatory substances, and turbidity in waters below the dam. The impact will be less than significant due to dilution and the timing of overtopping. Spills will only occur during rare and very large storm events when dilution of reclaimed water within the reservoir and dilution of the spill in the receiving waters will be high. In addition, spills will only occur in winter when the concentration in reservoirs of ammonia is low and dissolved oxygen is high, receiving water turbidity is high, and response to biostimulatory substances is low.

- Construction. The impact from construction on suspended sediment or other water quality constituents will be less than significant because of implementation of erosion control practices (see Measure 2.2.5 and 2.2.10).

- Change in flow in surface waterways. The presence of a reservoir will intercept runoff and affect streamflow. The change in streamflow is expected to cause a water quality change in the esteros.

Table 4.6-31

Surface Water Quality Impacts by Component - Storage Reservoirs

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
6.5.1. Will the storage reservoir component cause numeric-based criteria to be exceeded?				
Ammonia • West County, Tolay, and Sears Point storage sites	> numeric criteria which are temperature and pH dependent	up to 11 mg/L	O&M C	⊙ ==

Table 4.6-31

Surface Water Quality Impacts by Component - Storage Reservoirs

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
• Other storage sites			O&M C	○ ==
Dissolved Oxygen • West County, Tolay, and Sears Point storage sites	< 5 mg/L minimum	< 5 mg/L	O&M C	⊙ ==
• Other storage sites			O&M C	○ ==
Hydrogen Sulfide • West County, Tolay, and Sears Point storage sites	> 2 mg/L	> 2 mg/L	O&M C	⊙ ==
• Other storage sites			O&M C	○ ==
All other numeric criteria			O&M C	○ ==
6.5.2. Will the storage reservoir component cause narrative-based criteria to be exceeded?			O&M C	○ ==
6.5.3. Will the storage reservoir component impact special sites?				
Will the storage reservoir component cause water quality changes to occur in an Area of Special Biological Significance or in the Sanctuary. • West County reservoirs	Any water quality change	The concentration of water quality constituents will change	C O&M	== ●
• South County reservoirs		No Sanctuary or Area of Special Biological Significance in South County	O&M, C	==

Table 4.6-31

Surface Water Quality Impacts by Component - Storage Reservoirs

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
6.5.4. Will the storage reservoir component cause sediment quality evaluation criteria to be exceeded?				
All sediment criteria			O&M C	❍ ==

Source: *Water Quality Impacts Analysis*, Merritt Smith Consulting 1996r

Notes: [1]. Type of Impact:
C Construction
O&M Operation and Maintenance

[2]. Level of Significance codes:
● Significant impact before and after mitigation, except for the No Action component for which the symbol represents significant impact and no mitigation is proposed
⊙ Significant impact before mitigation; less than significant impact after mitigation
❍ Less than significant impact; no mitigation proposed
== No impact

Impact: **6.5.1. Ammonia. Will the storage reservoir component cause numeric-based criteria to be exceeded?**

Analysis: *Significant; Alternatives 2A, 2C, 2D, and 3.*

Americano Creek, Stemple Creek, and Tolay Creek Watersheds. Each of the storage reservoirs will become thermally stratified and the lower layer will quickly become anoxic (depleted of oxygen). Inorganic nitrogen will be converted to ammonia during the oxygen depletion process. Seepage from reservoirs will contain inorganic nitrogen at concentrations up to 11 mg/L in the summer. The majority of this inorganic nitrogen may be ammonia and the concentration of ammonia in waters below the storage reservoirs may be greater than the point of significance.

Less than Significant; Alternative 2B.

Watersheds of the Lakeville and Adobe Road storage sites. Seepage is not expected to reach surface water in watersheds of the Lakeville and Adobe Road storage sites because of local hydrogeological conditions (Questa Engineering Corporation, Inc. 1996b).

No Impact; Alternatives 1, 4, and 5.

These alternatives do not have a storage reservoir component.

Mitigation: *Alternatives 2A, 2C, 2D, and 3.*

2.5.3 Control Program for Hydrogen Sulfide, Ammonia, and Dissolved Oxygen

Alternatives 1, 2B, 4, and 5. No mitigation is proposed.

After Mitigation: *Less than Significant after Mitigation; Alternatives 2A, 2C, 2D, and 3.*

If ammonia is detected in the storage reservoir and the creek below the dam, a system of wells will be installed between the reservoirs and downstream receiving waters that will be operated to intercept shallow groundwater seeping from the storage site. Intercepted groundwater will be returned to the storage reservoir and, therefore, ammonia will be prevented from entering the creek below the dam.

Impact: 6.5.1. Dissolved Oxygen. Will the storage reservoir component cause numeric-based criteria to be exceeded?

Analysis: *Significant; Alternatives 2A, 2C, 2D, and 3.*

Americano Creek, Stemple Creek, and Tolay Creek Watersheds. Seepage of this lower layer of anoxic water from any of the storage reservoirs could suppress dissolved oxygen in surface waters to levels that are less than 5 mg/L (the applicable regulatory standard). Dissolved oxygen levels could remain below the standard in reaches of creek up to 120 feet below the dam.

Less than Significant; Alternative 2B

Watersheds of the Lakeville and Adobe Road storage sites. Seepage is not expected to reach surface water in watersheds of the Lakeville and Adobe Road storage sites (Questa Engineering Corporation, Inc. 1996b).

No Impact; Alternatives 1, 4, and 5.

These alternatives do not have a storage reservoir component.

Mitigation: *Alternative 2A, 2C, 2D, and 3.*

2.5.3. Control Program Hydrogen Sulfide, and Ammonia, and Dissolved Oxygen

Alternative 1, 2B, 4, and 5. No mitigation is proposed.

After Mitigation: *Less than Significant after Mitigation; Alternatives 2A, 2C, 2D, and 3.*

See discussion under Impact 6.5.1. Ammonia above.

Impact: 6.5.1. Hydrogen Sulfide. Will the storage reservoir component cause numeric-based criteria to be exceeded?

Analysis: *Significant; Alternatives 2A, 2C, 2D, and 3.*

Americano Creek, Stemple Creek, and Tolay Creek Watersheds. Seepage of this lower layer of hypolimnetic water from any of the storage reservoirs could result in hydrogen sulfide levels in excess of 2 mg/L (the applicable regulatory standard). Hydrogen sulfide levels could remain above the standard in reaches of creek up to 120 feet below the dam.

Less than Significant; Alternative 2B.

Watersheds of the Lakeville and Adobe Road storage sites. Seepage is not expected to reach surface water in watersheds of the Lakeville and Adobe Road storage sites (Questa Engineering Corporation 1996b).

No Impact; Alternatives 1, 4, and 5.

These alternatives do not have a storage reservoir component.

Mitigation: *Alternative 2A, 2C, 2D, and 3.*

2.5.3 Control Program for Hydrogen Sulfide, and Ammonia, and Dissolved Oxygen

Alternative 1, 4, and 5. No mitigation is proposed.

After Mitigation: *Less than Significant after Mitigation; Alternatives 2A, 2C, 2D, and 3.*

See discussion under Impact 6.5.1 Ammonia above.

Impact: 6.5.2. Will the storage reservoir component cause narrative-based criteria to be exceeded?

Analysis: *Less than Significant; Alternatives 2 and 3.*

As indicated in the *Water Quality Impacts Analysis* technical report (Merritt Smith Consulting 1996r), other impacts are considered to be less than significant.

No Impact; Alternatives 1, 4, and 5.

These alternatives do not have a storage reservoir component.

Mitigation: No mitigation is proposed.

Impact: 6.5.3. Will the storage reservoir component impact special sites?

Analysis: *Significant; Alternative 3.*

Seepage from storage reservoirs is expected to affect flow in West County streams, which is considered to be a significant impact under the special site criterion. West County streams flow into the esteros, which are part of the Gulf of the Farallones National Marine Sanctuary (a special site).

Impacts on water quality in the esteros are described in the Agricultural Irrigation section below.

No Impact; Alternatives 1, 2, 4, and 5.

Alternatives 1, 4, and 5 do not have a storage reservoir component. Alternative 2 does not have a storage component near special sites.

Mitigation: *Alternative 3.* No feasible mitigation has been identified, although mitigation was considered and evaluated (*see Water Quality Impacts Analysis Report, Volume I,* Merritt Smith Consulting 1996r).

Alternatives 1, 2, 4, and 5. No mitigation is needed.

Impact: 6.5.4. Will the storage reservoir component cause sediment quality criteria to be exceeded?

Analysis: *Less than Significant; Alternatives 2 and 3.*

Organic compounds for which criteria have been established are not expected to be present in storage-affected waters. Thus, the potential impact is considered to be less than significant.

No Impact; Alternatives 1, 4, and 5.

These alternatives do not have a storage reservoir component.

Mitigation: No mitigation is proposed.

Pump Station Component

Impact: 6.6.1-4. Will the pump station component impact water quality based on evaluation criteria 1 through 4?

Analysis: *No Impact; All Alternatives.*

Pump stations are not located near surface waters. Pump station construction is not expected to affect surface water quality based Measures 2.2.5 and 2.2.10, adopted as part of the Project.

Mitigation: No further mitigation is needed.

Agricultural Irrigation Component

Agricultural irrigation will impact surface water quality in the following ways:

- Accidental runoff from fields. If accidental agricultural runoff should occur, the maximum flow will be 0.1 cfs (see Hydrology section). Because of the small amount of flow and the short duration (estimated to be 12 hours), the impact on creek water quality will be less than significant.

- Agricultural irrigation percolate subflow discharging to surface waters. When irrigation percolate discharges to creeks it potentially alters the water quality of

the creeks. Impacts of agricultural irrigation from the commingling of percolate and surface water are discussed in this section.

Table 4.6-32

Surface Water Quality Impacts by Component – Agricultural Irrigation

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
6.7.1. Will the agricultural irrigation component cause numeric-based criteria to be exceeded?				
Dissolved copper • West County irrigation	14 µg/L	up to 15 µg/L	O&M O&M-CP	⊙ ⊙
• South County and Sebastopol irrigation		Less than 14 µg/L	O&M O&M-CP	❍ ❍
All other numeric criteria			O&M O&M-CP	❍ and ==
6.7.2. Will the agricultural component cause narrative-based criteria to be exceeded?				
All narrative criteria			O&M O&M-CP	❍ ❍
6.7.3. Will the agricultural irrigation component impact special sites?				
The Project may cause water quality changes to occur in an Area of Special Biological Significance or in the Sanctuary. • West County Irrigation	Any water quality change	The concentration of water quality constituents will be affected in the esteros	O&M O&M-CP	● ●
• South County and Sebastopol Irrigation		None	O&M	==
6.7.4. Will the agricultural irrigation component cause sediment quality evaluation criteria to be exceeded?				
All sediment criteria			O&M O&M-CP	❍ and == ❍ and ==

Source: *Water Quality Impacts Analysis*, Merritt Smith Consulting 1996r

Notes: [1]. Type of Impact:
O&M Operation and Maintenance
O&M-CP Operation and Maintenance - Contingency Plan

[2]. Level of Significance codes:
● Significant impact before and after mitigation,
⊙ Significant impact before mitigation; less than significant impact after mitigation
❍ Less than significant impact; no mitigation proposed

Impact: **6.7.1. Dissolved copper. Will the agricultural irrigation component cause numeric-based criteria to be exceeded?**

Analysis: *Significant; Alternative 3.*

Americano Creek Agricultural Irrigation Area. A combination of agricultural irrigation within the Bloomfield Valley (Bloomfield reservoir site) and operation of the Valley Ford, Carroll Road, Two Rock or Huntley reservoirs (any storage site but Bloomfield) will cause the concentration of dissolved copper in the Americano Creek tributary in the Bloomfield valley (but not Americano Creek) to exceed the point of significance. This is because more irrigation could occur at the Bloomfield storage site without a reservoir there than with the reservoir at the Bloomfield storage site. If irrigation were to occur at the Bloomfield storage site, the amount of irrigated land will be sufficiently large relative to the total area of the subwatershed (37%) that irrigation drainage will not be sufficiently diluted to avoid the exceedence.

Stemple Creek Agricultural Irrigation Area. Agricultural irrigation will cause exceedences of the point of significance for dissolved copper in Stemple Creek and in the tributaries in Huntley and Two Rock valleys, regardless of which storage site might be built.

The maximum concentration of dissolved copper predicted in both the Stemple and Americano watersheds with design agricultural irrigation is 0.015 mg/L. Assuming a hardness of 130 mg/L (the value measured in upper tributaries of both watersheds on one occasion), the point of significance for dissolved copper is 0.014 mg/L.

Winter irrigation at these sites will cause the concentration of dissolved copper in Americano Creek, the Americano Creek tributary at the Bloomfield reservoir, and the Americano Creek tributary at the Valley Ford reservoir to exceed the point of significance under some operating scenarios.

Stemple Creek Agricultural Irrigation Area. Exceedences of the point of significance for dissolved copper will occur throughout the watershed.

The maximum concentration of dissolved copper predicted in either the Stemple and Americano watersheds with contingency winter irrigation is 0.016 mg/L. Assuming a hardness of 130 mg/L, the point of significance for dissolved copper is 0.014 mg/L.

No Impact; Alternatives 1, 2, 4, and 5.

Sebastopol and South County Irrigation Areas. Extensive lands with shallow impermeable layers that will cause root zone saturation and lateral flow to surface waters generally do not occur in the Sebastopol or South County irrigation areas. Therefore, no measurable impact of summer and winter irrigation on Sebastopol or South County irrigation area lands on

surface water quality is expected (Questa Engineering Corporation, Inc. 1996b).

Alternatives 1, 4, and 5 do not have an agricultural irrigation component.

Mitigation: *Alternative 3.*

2.5.2. Control program for dissolved copper.

Alternative 1, 2, 4, and 5. No mitigation is needed.

After Mitigation: *Less than Significant after Mitigation; Alternative 3.*

Americano Creek and Stemple Creek Agricultural Irrigation Areas. Winter irrigation acreage will initially be limited to 4,500 acres in the Stemple watershed. Winter irrigation will be limited to 360 acres in the subwatershed in which the Bloomfield reservoir is located. These limitations are based on assumptions that will be verified by monitoring. Creeks in the Stemple and Americano watersheds will be monitored monthly for dissolved copper and hardness. With the monitoring information, the irrigation acreage limitations can then be adjusted to a size that will prevent exceedences of the dissolved copper criterion.

The concentrations of dissolved copper in Americano and Stemple Creeks and their tributaries with irrigation were estimated using an average reclaimed water concentration of dissolved copper from 1991 through January 1995 (0.010 mg/L) (Merritt Smith Consulting 1996k). In September 1995, the Sonoma County Water Agency began balancing the pH in drinking water for the purposes of reducing corrosion in water supply pipes. Reducing corrosion of copper water supply pipes will potentially reduce the concentration of dissolved copper in reclaimed water. The concentration of copper in reclaimed water since September 1995 is 0.08 mg/L (n = 2 samples), indicating a potential long-term reduction in dissolved copper (Merritt Smith Consulting 1996l). Therefore, the concentration of dissolved copper in irrigation water may also be reduced.

Contingency irrigation in the Stemple or Americano irrigation areas will not occur prior to collection of dissolved copper and hardness data (in association with design irrigation specified above), and an evaluation of the data to calculate the appropriate contingency irrigation acreage to avoid significant impacts. Contingency irrigation of the indicated acreage could be initiated based on the results of the evaluation. Monitoring of contingency irrigation impacts should be conducted to verify the impacts analysis that is based on the post-design irrigation monitoring data.

Impact: **6.7.2. Will the agricultural irrigation component cause narrative-based criteria to be exceeded?**

Analysis: *Less than Significant; Alternatives 2 and 3.*

Measures 2.2.1, 2.2.3, 2.2.4, 2.2.5, 2.2.6, and 2.2.7 will minimize the impact of irrigation and agriculture on streams. The technical analysis (Merritt Smith Consulting 1996r), shows that sediment and nutrient loads will be reduced by the Project. Thus, attainment of narrative objectives will be enhanced by the Project. This impact is considered to be less than significant.

No Impact; Alternatives 1, 4, and 5.

Alternatives 1, 4, and 5 do not have an agricultural irrigation component.

Mitigation: No further mitigation is proposed.

Impact: **6.7.3. Salinity, ammonia, dissolved oxygen, planktonic algae, benthic algae, and metals. Will the agricultural irrigation component cause the special site criterion to be exceeded?**

Analysis: *Significant; Alternative 3.*

Americano Creek and Stemple Creek Agricultural Irrigation Areas. Salinity, ammonia, dissolved oxygen, planktonic algae, benthic algae, and metals will be affected. Other constituents, such as algal growth nutrients, individual inorganic minerals (e.g., chloride), and organic compounds (e.g., naturally occurring organic acids) will also be affected in the esteros. The analysis shows that water quality throughout much of the esteros will potentially be affected, although the magnitude of the effect is usually small. The magnitude of the effect is dependent on time of year, estero inlet condition (open vs. closed), and hydrology (e.g., wet year).

No Impact; Alternatives 1, 2, 4, and 5.

Sebastopol and South County Irrigation Areas. There are no Areas of Special Biological Significance or Sanctuaries in the Sebastopol or South County Agricultural Irrigation Areas, and so no significant impacts have been identified.

Alternatives 1, 2, 4, and 5 do not have an agricultural irrigation component.

Mitigation: *Alternative 3.* No feasible mitigation has been identified (Merritt Smith Consulting 1996r).

Alternatives 1, 2, 4, and 5. No mitigation is needed.

Impact: **6.7.4. Will the agricultural irrigation component cause sediment quality criteria to be exceeded?**

Analysis: *Less than Significant; Alternatives 2 and 3.*

Organic compounds for which criteria have been established are not expected to be present in irrigation percolate from areas irrigated with reclaimed water. Thus, the potential impact is considered to be less than significant.

No Impact; Alternatives 1, 4, and 5.

Alternatives 1, 4, and 5 do not have an agricultural irrigation component.

Mitigation: No mitigation is proposed.

Geysers Steamfield Component

Impact: **6.8.1-4. Will the geysers steamfield component impact water quality under evaluation criteria 1 through 4?**

Analysis: *No Impact; All Alternatives.*

Geysers injection will not result in discharge to surface water. Within the steamfield, all reclaimed water will be used for subsurface injection, which is discussed in Section 4.5, Groundwater.

Alternatives 1, 2, 3, and 5 do not have a geysers steamfield component.

Mitigation: No mitigation is needed.

Discharge Component

The analysis of discharge impacts involved evaluation of five discharge scenarios (see Table 4.6-28) in four waters (Santa Rosa Creek, Laguna de Santa Rosa, Russian River above the Laguna, and Russian River below the Laguna) under three different hydrologic conditions (dry, normal, and wet) for 55 constituents identified in Table 4.6-27. The analysis was necessarily complex for the sake of thoroughness.

Reclaimed water discharge impacts were evaluated using a model that simulated dilution of reclaimed water (and thus the concentration of constituents such as metals) and biological processes of algal growth, sediment uptake and release of nutrients, and dissolved oxygen. The following characteristics of reclaimed water and the receiving waters interact to produce the results predicted by the model:

- Reclaimed water quality. The quality of reclaimed water affects the quality of receiving waters such as Santa Rosa Creek, the Laguna, and the Russian River directly and indirectly. Direct impacts include the effect of reclaimed water on the concentration of a constituent in the receiving water. Some reclaimed water quality constituents, such as nitrogen, can have an indirect effect. Since algae in the receiving waters are often nitrogen limited, an increase in nitrogen

loading often (though not always) produces an increase in algal growth. Toxicity and bioaccumulation are also potential indirect effects. Toxicity is addressed in this section, and bioaccumulation is addressed in Section 4.9, Aquatic Biological Resources.

- Volume of discharge. The effect of reclaimed water constituents depends in part on the amount of reclaimed water discharged relative to creek flow. As reclaimed water discharge increases, it has an increasing influence on receiving water quality. In addition, the flow resulting from the discharge can affect receiving water quality. For example, light can, at times, limit growth of benthic algae. Changes in the volume of reclaimed water discharged can change the depth of the receiving waters and thus, change light availability. For example, the reduction in discharge associated with the geysers discharge component is predicted to, in some cases, increase benthic algal growth through a reduction in creek depth and the consequent increase in light availability. Also, increased reclaimed water discharge will tend to decrease the residence time of water in the Laguna and reduce the estimated planktonic algal growth.

- River flow. The potential impacts of each Project alternative and the existing condition were simulated using the hourly river flow conditions for a dry, normal, and wet year. The potential effect of reclaimed water on receiving water quality varied substantially between types of hydrologic year because of the effect of hydrology on reclaimed water concentration, flushing, water depth, and light penetration.

- Discharge operations. The timing of discharge affects water quality impacts. For example, reclaimed water discharge during winter will have a less dramatic effect on algae than will discharge in fall or spring due to conditions of reduced light and temperature. Each discharge scenario is defined in terms of a unique set of characteristics, including storage volume, monthly storage objectives, maximum allowable discharge rate relative to river flow, hydraulic capacity of conveyance facilities such as pipes and pumps, and reclaimed water production. In addition, the simulated operation of each Project alternative differed from the simulated existing condition in that the existing condition discharge does not commence until the 1000 cfs threshold is achieved in the Russian River. No such restriction is associated with the Project alternatives (North Coast Regional Board 1994).

Significant adverse and significant beneficial impacts of discharge scenarios are described below and summarized in Table 4.6-33.

Table 4.6-33

Significant Adverse and Beneficial Impacts of Each Alternative[1] Before and After Mitigation[2]

Constituent	Santa Rosa Creek	Laguna	Russian River Below Laguna	Russian River Above Laguna
Conductivity				*5A*
Cyanide	*1*, ~~*5B*~~	*1*, ~~*5B*~~		
Dissolved Oxygen	*5B*	*5B*		
Benthic Algae • Adverse	*1*, 2&3, 4, 5A, 5B	*1*, 2&3, 4, 5A, 5B	*1*, 5A, 5B	5A
• Beneficial	*1*, 2&3, 4, 5A, **5B**	*1*, 2&3, 4, 5A, **5B**	*1*, 2&3, 4, 5A, **5B**	
Planktonic Algae • Adverse		2&3, 5A	5B	5A
• Beneficial	*1*, 5B	*1*, 5B	5A	
Turbidity • Adverse				~~5A~~
• Beneficial	*1*, ~~5B~~	*1*, ~~5B~~	5A	
Waste Reduction Strategy				
• Total Nitrogen				
♦ Adverse	*1*, ~~5B~~			
♦ Beneficial	2&3, 4, 5A			
• Ammonia N				
♦ Adverse	*1*, ~~5B~~		Criterion applies only to Laguna system	
♦ Beneficial	2&3, 4, 5A			
Toxicity	*1*, ~~5B~~			

Source: Section 4, *Water Quality Impacts Analysis*, Merritt Smith Consulting 1996r

1. Components causing a significant adverse or beneficial impact are shown. Overstriking indicates impact avoided with mitigation, italics indicates no mitigation proposed, bold indicates impacts that are significant after mitigation that are not significant before mitigation. Components are identified as follows:
   1 = (Alt 1) - No Action discharge scenario
   2&3 = (Alts 2&3) - 1% design discharge scenario
   4 = (Alt 4) - Geysers discharge scenario
   5A = (Alt 5A) - 20% design discharge scenario to River
   5B = (Alt 5B) - 20% design discharge scenario to Laguna
2. Mitigation of benthic algae, planktonic algae, and dissolved oxygen involves revising discharge operations to minimize discharge during fall and spring. Mitigation for waste reduction strategy (total nitrogen load and ammonia load) is to reduce nitrogen load to the Laguna at appropriate sources. Mitigation for the No Action discharge scenario (Alt 1) is not considered in this EIR/EIS.

Summary of Significant Adverse Impacts

Significant adverse impacts of reclaimed water discharge scenarios have been identified for particular constituents and are summarized in Table 4.6-33. In addition to the discharge impacts identified in Table 4.6-33, contingency discharge associated with the 20% discharge scenarios was found to have the same significant adverse impacts as the 20% design discharge scenarios except that the magnitude of algal biostimulation was reduced (because of increased flushing to reduce phytoplankton growth and increased water depth to limit benthic algal growth).

Summary of Significant Beneficial Impacts

Discharge of reclaimed water has the potential to alter water quality in a fashion that is considered beneficial under the evaluation criteria for benthic algae, planktonic algae, turbidity, and load reduction strategy criteria. In the case of benthic algae, planktonic algae, and turbidity, a discharge scenario could cause both adverse and beneficial impacts depending on month and location. For example, the 20% design discharge scenario in the Laguna could stimulate benthic algal growth in Santa Rosa Creek while simultaneously flushing the Laguna to reduce planktonic algae biomass. Significant beneficial impacts are summarized in Table 4.6-33.

Comparison of Significant Adverse and Beneficial Impacts

Criteria have been established to identify adverse and beneficial impacts for benthic algae, planktonic algae, turbidity, and waste load reduction strategy. Potential impacts of each discharge scenario were evaluated in several creek reaches during each month of each of three hydrologic years. Thus, in any particular reach during any particular month, the impact could be significant beneficial, significant adverse, or less than significant. A comparison of the number of significant adverse to the number of significant beneficial impacts shows that the 20% design discharge scenarios and the No Action Alternative generally cause more adverse than beneficial impacts. Mitigation is proposed for the 20% design discharge scenarios that results in more beneficial than adverse impacts, but mitigation has not been identified that will eliminate all potential adverse impacts.

Table 4.6-34 presents significant impacts due to discharge for each criterion.

Table 4.6-34

Surface Water Quality Impacts by Component - Discharge

		Russian River			Laguna de Santa Rosa and Santa Rosa Creek		
Evaluation Criteria	**Point of Significance[1]**	**Impact**	**Type of Impact[2]**	**Level of Signifi-cance[3]**	**Impact**	**Type of Impact[2]**	**Level of Signifi-cance[3]**
6.9.1. Will the discharge component cause numeric-based criteria to be exceeded?							
Conductivity	50th percentile (median) of monthly average in the Russian River above the Laguna> 250 μmhos/cm or 50th percentile (median) of monthly average in the Russian River below the Laguna> 285 μmhos/cm	Median monthly average values given in μmhos/cm for River above Laguna (Uppr Rvr) or below Laguna (Lwr Rvr)			Not applicable to the Laguna and Santa Rosa Creek		
• Alt 1 - No Action discharge		Uppr Rvr = no change Lwr Rvr = 272	O&M	❍			
• Alt 2 and 3 - 1% design discharge		Uppr Rvr = no change Lwr Rvr = 263	O&M	❍			
• Alt 4 - Geysers discharge		Uppr Rvr = no change Lwr Rvr = 262	O&M	❍			
• Alt 5A - 20% design discharge to the Russian River		Uppr Rvr= 265 Lwr Rvr = 272	O&M	●			
		Uppr Rvr=270 Lwr Rvr=264	O&M-CP	●			

Table 4.6-34

Surface Water Quality Impacts by Component - Discharge

		Russian River			Laguna de Santa Rosa and Santa Rosa Creek		
Evaluation Criteria	**Point of Significance[1]**	**Impact**	**Type of Impact[2]**	**Level of Significance[3]**	**Impact**	**Type of Impact[2]**	**Level of Significance[3]**
• Alt 5B - 20% design discharge to the Laguna		Uppr Rvr = no change Lwr Rvr = 277 Lwr Rvr=260	O&M O&M-CP	○ ○			
Cyanide	>0.0052 mg/L						
• Alt 1 - No Action discharge		0.0033 mg/L	O&M	○	0.0075 mg/L	O&M	●
• Alt 2 and 3 - 1% design discharge		0.0025 mg/L	O&M	○	0.0009 mg/L	O&M	○
• Alt 4 - Geysers discharge		0.0025 mg/L	O&M	○	0.0006 mg/L	O&M	○
• Alt 5A - 20% design discharge to the Russian River		0.0033 mg/L 0.0035 mg/L	O&M O&M-CP	○ ○	0.0002 mg/L 0.0000 mg/L	O&M O&M-CP	○ ○
• Alt 5B - 20% design discharge to the Laguna		0.0036 mg/L 0.0041 mg/L	O&M O&M-CP	○ ○	0.0081 mg/L 0.0080 mg/L	O&M O&M-CP	⊙ ⊙

Table 4.6-34

Surface Water Quality Impacts by Component - Discharge

		Russian River			Laguna de Santa Rosa and Santa Rosa Creek		
Evaluation Criteria	**Point of Significance[1]**	**Impact**	**Type of Impact[2]**	**Level of Signifi-cance[3]**	**Impact**	**Type of Impact[2]**	**Level of Signifi-cance[3]**
Dissolved Oxygen	> 7 mg/L minimum and 10 mg/L 50th percentile monthly average or any decrease if receiving water not in compliance						
• Alt 1 - No Action discharge	Upper row shows the lowest minimum monthly	8.8 mg/L, 9.5 mg/L <0.5 mg/L decrease	O&M	○	7.0 mg/L, 8.2 mg/L <0.5 mg/L decrease	O&M	○
• Alt 2 and 3 - 1% design discharge	average and lowest median monthly average	8.6 mg/L, 9.6 mg/L <0.5 mg/L decrease	O&M	○	7.0 mg/L, 8.3 mg/L <0.5 mg/L decrease	O&M	○
• Alt 4 - Geysers discharge	value of the 3 hydrologic years. Lower row shows	8.9 mg/L, 9.6 mg/L <0.5 mg/L decrease	O&M	○	7.0 mg/L, 8.3 mg/L <0.5 mg/L decrease	O&M	○
• Alt 5A - 20% design discharge to the Russian River	change from existing conditions.	9.0 mg/L, 9.5 mg/L <0.5 mg/L decrease	O&M	○	7.0 mg/L, 8.3 mg/L <0.5 mg/L decrease	O&M	○
		<0.5 mg/L decrease	O&M-CP	○	<0.5 mg/L decrease	O&M-CP	○

Table 4.6-34

Surface Water Quality Impacts by Component - Discharge

		Russian River			Laguna de Santa Rosa and Santa Rosa Creek		
Evaluation Criteria	**Point of Significance[1]**	**Impact**	**Type of Impact[2]**	**Level of Signifi-cance[3]**	**Impact**	**Type of Impact[2]**	**Level of Signifi-cance[3]**
• Alt 5B - 20% design discharge to the Laguna	Less than 0.5 mg/L change not considered significant.	8.8 mg/L, 9.5 mg/L <0.5 mg/L decrease	O&M	○	7.0 mg/L, 8.2 mg/L 0.5 mg/L decrease	O&M	●
		<0.5 mg/L decrease	O&M-CP	○	<0.5 mg/L decrease	O&M-CP	○
All other numeric-based criteria.			C P O&M O&M-CP	○ == ○ ○		C P O&M O&M-CP	○ == ○ ○
6.9.2. Will the discharge component cause narrative-based criteria to be exceeded?							
Biostimulatory substances - Adverse	> 10% increase in chlorophyll *a*, monthly average	(number shown for higher of benthic algae or planktonic algae)			(number shown for higher of benthic algae or planktonic algae)		
• Alt 1 - No Action discharge		69% increase	O&M	●	134% increase	O&M	●
• Alt 2 and 3 - 1% design Discharge		<1% increase	O&M	○	29% increase	O&M	●
• Alt 4 - Geysers		3% increase	O&M	○	40% increase	O&M	●

Table 4.6-34

Surface Water Quality Impacts by Component - Discharge

		Russian River			Laguna de Santa Rosa and Santa Rosa Creek		
Evaluation Criteria	**Point of Significance[1]**	**Impact**	**Type of Impact[2]**	**Level of Significance[3]**	**Impact**	**Type of Impact[2]**	**Level of Significance[3]**
discharge							
• Alt 5A - 20% design discharge to the Russian River		147% increase	O&M	●	25% increase	O&M	●
		29% increase	O&M-CP	●	91% increase	O&M-CP	●
• Alt 5B - 20% design discharge to the Laguna		80% increase	O&M	●	134% increase	O&M	●
		10% increase	O&M-CP	●	27% increase	O&M-CP	●
Biostimulatory substances - Beneficial	>10% decrease in chlorophyll *a*, monthly average (from non-toxic factors)						
• Alt 1 - No Action discharge		2% decrease	O&M	○	27% decrease	O&M	+
• Alt 2 and 3 - 1% design discharge		20% decrease	O&M	+	36% decrease	O&M	+
• Alt 4 - Geysers discharge		23% decrease	O&M	+	23% decrease	O&M	+

Table 4.6-34

Surface Water Quality Impacts by Component - Discharge

		Russian River			Laguna de Santa Rosa and Santa Rosa Creek		
Evaluation Criteria	**Point of Significance[1]**	**Impact**	**Type of Impact[2]**	**Level of Signifi-cance[3]**	**Impact**	**Type of Impact[2]**	**Level of Signifi-cance[3]**
• Alt 5A - 20% design discharge to the Russian River		34% decrease	O&M	+	33% decrease	O&M	+
		<1% decrease	O&M-CP	○	5% decrease	O&M-CP	○
• Alt 5B - 20% design discharge to the Laguna		2% decrease	O&M	○/+	32% decrease	O&M	+
		<1% decrease	O&M-CP	○	4% decrease	O&M-CP	○/+
Turbidity - Adverse	>20% increase						
• Alt 1 - No Action discharge		8% increase	O&M	○	3% increase	O&M	○
• Alt 2 and 3 - 1% design Discharge		<1% increase	O&M	○	10% increase	O&M	○
• Alt 4 - Geysers discharge		<1% increase	O&M	○	7% increase	O&M	○
• Alt 5A - 20% design discharge to the Russian River		20% increase	O&M	⊙	10% increase	O&M	○
		29% increase	O&M-CP	⊙	91% increase	O&M-CP	●
• Alt 5B - 20%		12% increase	O&M	○	2% increase	O&M	○

Table 4.6-34

Surface Water Quality Impacts by Component - Discharge

		Russian River			Laguna de Santa Rosa and Santa Rosa Creek		
Evaluation Criteria	Point of Significance[1]	Impact	Type of Impact[2]	Level of Significance[3]	Impact	Type of Impact[2]	Level of Significance[3]
dDesign discharge to the Laguna		10% increase	O&M-CP	❍	27% increase	O&M-CP	●
Turbidity -Beneficial • Alt 1 - No Action discharge	>20% decrease	2% decrease	O&M	❍	27% decrease	O&M	+/❍
• Alt 2 and 3 - 1% design Discharge		7% decrease	O&M	❍	<1% decrease	O&M	❍
• Alt 4 - Geysers discharge		7% decrease	O&M	❍	<1% decrease	O&M	❍
• Alt 5A - 20% design discharge to the Russian River		34% decrease	O&M	+	<1% decrease	O&M	❍
		<1% decrease	O&M-CP	❍	<1% decrease	O&M-CP	❍
• Alt 5B - 20% design discharge to the Laguna		2% decrease	O&M	❍	32% decrease	O&M	+/❍
		<1% decrease	O&M-CP	❍	4% decrease	O&M-CP	❍
Waste Reduction Strategy Total Nitrogen -	< 159,000 lb/yr total Nitrogen reduction in the Laguna	Not applicable to the Russian River					

Table 4.6-34

Surface Water Quality Impacts by Component - Discharge

		Russian River			Laguna de Santa Rosa and Santa Rosa Creek		
Evaluation Criteria	**Point of Significance[1]**	**Impact**	**Type of Impact[2]**	**Level of Significance[3]**	**Impact**	**Type of Impact[2]**	**Level of Significance[3]**
Adverse • Alt 1 - No Action discharge					252,000 lb/yr increase	O&M	●
• Alt 2 and 3 - 1% design discharge					329,000 lb/yr decrease	O&M	❍
• Alt 4 - Geysers discharge					361,000 lb/yr decrease	O&M	❍
• Alt 5A - 20% design discharge to the Russian River					352,000 lb/yr decrease	O&M	❍
• Alt 5B - 20% design discharge to the Laguna					223,000 lb/yr increase	O&M	⊙
Waste Reduction Strategy **Total Nitrogen-Beneficial** • Alt 1 - No Action discharge	>159,000 lb/yr total Nitrogen reduction in the Laguna	Not applicable to the Russian River			252,000 lb/yr increase	O&M	❍
• Alt 2 and 3 - 1% design discharge					329,000 lb/yr decrease	O&M	+
• Alt 4 - Geysers discharge					361,000 lb/yr decrease	O&M	+

Table 4.6-34

Surface Water Quality Impacts by Component - Discharge

		Russian River			Laguna de Santa Rosa and Santa Rosa Creek		
Evaluation Criteria	**Point of Significance[1]**	**Impact**	**Type of Impact[2]**	**Level of Significance[3]**	**Impact**	**Type of Impact[2]**	**Level of Significance[3]**
• Alt 5A - 20% design discharge to the Russian River					352,000 lb/yr decrease	O&M	+
• Alt 5B - 20% design discharge to the Laguna					223,000 lb/yr increase	O&M	❍/+
Waste Reduction Strategy **Ammonia-Nitrogen - Adverse** • Alt 1 - No Action discharge	< 21,500 lb/yr Ammonia-Nitrogen reduction in the Laguna	Not applicable to the Russian River			16,800 lb/yr decrease	O&M	●
• Alt 2 and 3 - 1% design discharge					51,000 lb/yr decrease	O&M	❍
• Alt 4 - Geysers discharge					52,900 lb/yr decrease	O&M	❍
• Alt 5A - 20% design discharge to the Russian River					52,300 lb/yr decrease	O&M	❍

Table 4.6-34

Surface Water Quality Impacts by Component - Discharge

		Russian River			Laguna de Santa Rosa and Santa Rosa Creek		
Evaluation Criteria	**Point of Significance[1]**	**Impact**	**Type of Impact[2]**	**Level of Signifi-cance[3]**	**Impact**	**Type of Impact[2]**	**Level of Signifi-cance[3]**
• Alt 5B - 20% design discharge to the Laguna					18,500 lb/yr decrease	O&M	⊙
Waste Reduction Strategy Ammonia-Nitrogen-Beneficial	>21,500 lb/yr Ammonia-Nitrogen reduction in the Laguna	Not Applicable to the Russian River					
• Alt 1 - No Action discharge					16,800 lb/yr decrease	O&M	○
• Alt 2 and 3 - 1% design discharge					51,000 lb/yr decrease	O&M	+
• Alt 4 - Geysers discharge					52,900 lb/yr decrease	O&M	+
• Alt 5A - 20% design discharge to the Russian River					52,300 lb/yr decrease	O&M	+
• Alt 5B - 20% design discharge to the Laguna					18,500 lb/yr decrease	O&M	○/+
Toxicity (lethal effects)	any increase in frequency above 6.1%	Evaluated in Santa Rosa Ck only, where worst-case conditions will occur					
• Alt 1 - No Action discharge					7.9% frequency	O&M	●

Table 4.6-34

Surface Water Quality Impacts by Component - Discharge

		Russian River			Laguna de Santa Rosa and Santa Rosa Creek		
Evaluation Criteria	**Point of Significance[1]**	**Impact**	**Type of Impact[2]**	**Level of Significance[3]**	**Impact**	**Type of Impact[2]**	**Level of Significance[3]**
• Alt 2 and 3 - 1% design discharge					0% frequency	O&M	❍
• Alt 4 - Geysers discharge					0% frequency	O&M	❍
• Alt 5A - 20% design discharge to the Russian River					0% frequency 0% frequency	O&M O&M-CP	❍ ❍
• Alt 5B - 20% Design discharge to the Laguna					8.4% frequency 9.0% frequency	O&M O&M-CP	⊙ ⊙
All other narrative-based criteria.			C P O&M O&M-CP	❍ == ❍ ❍		C P O&M O&M-CP	❍ == ❍ ❍
6.9.3. Special site criteria							
Will the discharge component cause water quality changes to occur in an Area of Special Biological Significance		--	--			--	--

Table 4.6-34

Surface Water Quality Impacts by Component - Discharge

		Russian River			Laguna de Santa Rosa and Santa Rosa Creek		
Evaluation Criteria	**Point of Significance[1]**	**Impact**	**Type of Impact[2]**	**Level of Signifi-cance[3]**	**Impact**	**Type of Impact[2]**	**Level of Signifi-cance[3]**
or in the Sanctuary?							
6.9.4. Will the discharge component cause sediment quality evaluation criteria to be exceeded?							
Sediment			C P O&M O&M-CP	○ == ○ ○		C P O&M O&M-CP	== == ○ ○

Source: *Water Quality Impacts Analysis* and *Sediment Quality Characterization for the Russian River, Laguna de Santa Rosa , Santa Rosa Creek, and Reclaimed Water Storage Ponds*, Merritt Smith Consulting 1996o, r

1. As described in the *Development of Water Quality Criteria for Potential Water Quality Impacts* Technical Report, (Merritt Smith Consulting 1996f), effects of water quality on aquatic life may be significant even if water quality significance criteria are not exceeded. Water quality effects on aquatic life are described in Chapter 4.9, Aquatic Biological Resources.

2. Type of Impact:

C	Construction
O&M	Operation and Maintenance
O&M-CP	Operation and Maintenance - Contingency Plan
P	Permanent
--	Not Applicable

3. Level of Significance:

--	Not Applicable
==	No impact
○	Less than significant impact; no mitigation proposed
⊙	Significant impact before mitigation; less than significant impact after mitigation
●	Significant impact before and after mitigation, except for the No Action component for which the symbol represents significant impact and no mitigation is proposed
○/●	Impact less than significant before mitigation but significant after mitigation
○/+	Impact less than significant before mitigation and beneficial after mitigation
+/○	Impact beneficial before mitigation and less than significant after mitigation
+	Beneficial impact before and after mitigation

Impact: **6.9.1. Conductivity. Will the discharge component cause numeric-based criteria to be exceeded?**

Analysis: *Laguna and Santa Rosa Creek*

The conductivity evaluation criterion does not apply to the Laguna or Santa Rosa Creek.

Russian River

Significant; Alternative 5A.

Discharge to the Russian River may cause exceedence of the conductivity criterion in the Russian River. Conductivity is dependent upon the salt content of the water. Reclaimed water always contains more electro-conductive salts than the River, since reclaimed water derives from the River and salts are among the contaminants added as water is converted to sewage. Salts are not removed in the treatment process. Therefore, any discharge elevates the conductivity of the River. The Regional Board has established a 50th percentile water quality objective for conductivity of 250 µmhos/cm in the River above the confluence with the Laguna de Santa Rosa. This standard is the point of significance for conductivity evaluation criterion. The 50th percentile standard is met in the River currently. The attainment of the 50th percentile standard is determined using the average monthly conductivity in a calendar year. If the average monthly conductivity exceeds 250 µmhos/cm in six or more months, the River will be considered to be in non-attainment of the standard (i.e., the standard is attained if the median of twelve monthly average values is less than 250 µmhos/cm).

The 20% design discharge to the Russian River could cause conductivity in the Russian River above the Laguna to increase by as much as about 45 µmhos/cm. This estimate is conservative since lack of data in the upper River required the use of conductivity data from the Russian River below the confluence with the Laguna to estimate impacts (Merritt Smith Consulting 1996r). Since the Russian River below the confluence contains reclaimed water, conductivity in the Russian River above the confluence is likely to be lower. In some months during the discharge season that do not currently exceed the 250 µmhos/cm point of significance, this increment is sufficient to cause the average to exceed 250 µmhos/cm. The average conductivity is predicted to exceed the point of significance in nine of the twelve months.

The 20% design discharge to the Russian River with contingency discharge could cause conductivity in the Russian River above the Laguna to increase by as much as about 50 µmhos/cm. In some months during the discharge season that do not currently exceed the 250 µmhos/cm point of significance, this increment is sufficient to cause the average to exceed

250 μmhos/cm. The average conductivity is predicted to exceed the point of significance in nine of the twelve months. Thus, according to the conductivity evaluation criterion, this will be considered a significant impact.

Less than Significant; Alternatives 1, 2, 3, 4, and 5B.

These alternatives do not result in discharge to the Russian River above the Laguna, where the more stringent water quality objective of 250 μmhos/cm is applicable. These alternatives will not cause the less stringent conductivity objective of 285 μmhos/cm to be exceeded in the Russian River below the Laguna.

None of the Laguna discharge scenarios will cause the 50th percentile objective to be exceeded with contingency discharge.

Mitigation: *Alternative 5A.* No feasible mitigation has been identified.

Alternative 1, 2, 3, 4, and 5B. No mitigation is proposed.

Impact: 6.9.1. Cyanide. Will the discharge component cause numeric-based criteria to be exceeded?

Analysis: ***Operation and Maintenance***

Laguna and Santa Rosa Creek

Significant; Alternative 1 and 5B.

These discharge scenarios may cause total cyanide to exceed the water quality criterion for cyanide (0.0052 mg/L) in the Laguna and Santa Rosa Creek (Table 4.6-35). The average concentration of cyanide in reclaimed water is 0.010 mg/L, which exceeds the point of significance for cyanide and, if discharged directly, could cause significant impacts to the Laguna and Santa Rosa Creek with the No Action and 20% design discharge to the Laguna alternatives. However, reclaimed water is stored prior to discharge. Recent cyanide data collected from reclaimed water storage ponds (Delta and Meadowlane Ponds) indicate that, with storage, cyanide volatilizes and/or complexes with other compounds. The resulting total cyanide concentration in stored reclaimed water (n = 8 samples) was below detection (<0.0005 mg/L) and less than the point of significance for cyanide.

Less than Significant; Alternatives 2, 3, 4, and 5A.

None of these discharge scenarios will cause total cyanide to exceed the water quality criterion for cyanide in the Laguna or Santa Rosa Creek, even if reclaimed water is discharged directly (without storage).

Russian River

Less than Significant; All Alternatives

None of the discharge scenarios are predicted to cause total cyanide to exceed the water quality criterion for cyanide in the Russian River above or below the confluence with the Laguna.

Operation and Maintenance - Contingency Plan

Laguna and Santa Rosa Creek

Significant; Alternative 5B.

Discharge of reclaimed water under this scenario will cause the concentration of cyanide in the Laguna and/or Santa Rosa Creek to exceed the criterion for cyanide. The 95th percentile reclaimed water concentration during the driest year on record (1977) will result in an estimated cyanide concentration of 0.008 mg/L, which is greater than the 0.0052 mg/L point of significance.

Less than Significant; Alternative 5A.

The discharge scenario for Alternative 5A will not cause the concentration of cyanide in the Laguna and/or Santa Rosa Creek to exceed the criterion for cyanide.

No Impact; Alternatives 1, 2, 3, and 4.

These alternatives do not have contingency discharge.

Table 4.6-35

Effects of Unstored Design Discharge on Cyanide in the Laguna (in mg/L)

Discharge Scenarios	Effect[1,2]
Alt -1 No Project discharge	0.0075
Alt 2 & 3 - 1% Design discharge	0.0009
Alt 4 - Geysers discharge	0.0006
Alt 5A - 20% Design discharge to the Russian River	0.0002
Alt 5B - 20% Design discharge to the Laguna	0.0081

Source: *Water Quality Impacts Analysis*, Merritt Smith Consulting 1996r

Notes:
1. Value shown is for Santa Rosa Creek or the Laguna, whichever is higher.
2. Existing conditions data are not available so these numbers were calculated using a receiving water cyanide concentration of 0 mg/L, plant effluent (unstored) cyanide concentration of 0.010mg/L, and the 95th percentile reclaimed water concentration in a dry year. Data from storage ponds indicate actual discharged reclaimed water concentration will be lower than that in plant effluent.

Russian River

Less than Significant; Alternative 5.

Contingency discharge is not predicted to cause total cyanide to exceed the water quality criterion for cyanide in the Russian River above or below the confluence with the Laguna.

No Impact; Alternatives 1, 2, 3, and 4.

These alternatives do not have contingency discharge.

Mitigation: *Alternative 5B.*

2.5.6. Cyanide Monitoring and Source Control Program

Alternatives 1, 2, 3, 4, and 5A. No mitigation is proposed.

After Mitigation: *Significant; Alternative 1.*

The No Action (No Project) Alternative, by definition, does not include mitigation.

Less than Significant after Mitigation; Alternative 5B.

Monitoring will determine if source control is needed. If the concentration of cyanide in a storage pond exceeds the concentration determined to cause no impact for three consecutive samples or if the annual average cyanide concentration in a storage pond exceeds the concentration determined to cause no impact, the City shall implement a cyanide source control program.

Cyanide is known to be introduced into the Subregional System sewer at only a few locations. With implementation of the source control program, cyanide levels will be reduced to a level below significance by enforcement of limits for industrial dischargers of cyanide as needed to avoid exceeding the cyanide point of significance in receiving waters.

Impact: **6.9.1. Dissolved oxygen. Will the discharge component cause numeric-based criteria to be exceeded?**

Analysis: ***Operation and Maintenance***

Laguna and Santa Rosa Creek

Significant; Alternative 5B

The Laguna is rarely in attainment of the Basin Plan objectives for dissolved oxygen. Nutrients that derive from reclaimed water and other sources (North Coast Regional Board 1995) stimulate growth of algae (see 6.9.2, Narrative-based Evaluation Criteria section below), and the increase in algae consumes dissolved oxygen at night (when no photosynthesis can

occur) more rapidly than oxygen is replenished from the atmosphere. Therefore, a contribution to a reduction of dissolved oxygen on the part of the Project would be considered significant, because it will worsen an existing exceedence of the standards. The 20% discharge scenario will reduce dissolved oxygen in the Laguna and/or Santa Rosa Creek by up to 0.5 mg/L (a difference of less than 0.5 mg/L was considered insignificant due to insufficient model precision). This reduction in dissolved oxygen will be from 9.61 mg/L to 9.10 mg/L.

Less than Significant; Alternatives 1, 2, 3, 4, and 5A.

The impacts of discharge on dissolved oxygen in the Laguna and Santa Rosa Creek are less than significant for all discharge scenarios except 20% design discharge to the Laguna (see Table 4.6-36).

Table 4.6-36

Effects of Discharge on Dissolved Oxygen in the Laguna and Santa Rosa Creek (mg/L)

Discharge Scenarios	Lowest Monthly Average of 3 Hydrologic Years[1]	Lowest Median Monthly Average Value of 3 Hydrologic Years[2]	Maximum Effects Relative to Existing Conditions Baseline[3]
Alt 1 - No Action discharge	7.0	8.2	<0.5
Alt 2 & 3 - 1% Design discharge	7.0	8.3	<0.5
Alt 4 - Geysers discharge	7.0	8.3	<0.5
Alt 5A - 20% Design discharge to the Russian River	7.0	8.3	<0.5
Alt 5 B 20% Design discharge to the Laguna	7.0	8.2	0.5[4]
Existing Conditions	7.0	8.3	-

Source: *Water Quality Impacts Analysis*, Merritt Smith Consulting 1996r

1. Value shown is the lowest model predicted monthly average dissolved oxygen concentration of the three hydrologic years (normal dry, wet) for Santa Rosa Creek and the Laguna. The lowest value was identified from among 72 possible values (12 months x 3 years x 2 location).
2. Value shown is the lowest of the six median monthly average dissolved oxygen concentration (one median of 12 monthly average dissolved oxygen values for each of the hydrologic years for Santa Rosa Creek and the Laguna).
3. Value shown is the largest difference between existing monthly average dissolved oxygen concentrations and predicted monthly average dissolved oxygen for discharge scenario. The largest difference was identified from among 72 possible values (see footnote 1).
4. The maximum difference between existing monthly average dissolved oxygen and predicted monthly average dissolved oxygen with Alternative 5 B occurred in a month that was not the lowest of the three hydrologic years nor the lowest median monthly average.

Russian River

Less than Significant; All Alternatives.

The impacts of discharge on dissolved oxygen in the Russian River are less than significant because predicted dissolved oxygen concentrations for all discharge scenarios are not different from existing conditions (<0.5 mg/L difference between predicted dissolved oxygen and existing dissolved oxygen).

Operation and Maintenance - Contingency Plan

Laguna and Santa Rosa Creek

Less than Significant; Alternatives 5.

The impacts of contingency discharge on dissolved oxygen in the Laguna and Santa Rosa Creek are less than significant.

No Impact; Alternatives 1, 2, 3, and 4.

These alternatives are not expected to have a contingency discharge.

Russian River

Less than Significant; Alternative 5.

The impacts of contingency discharge on dissolved oxygen in the Russian River are less than significant.

No Impact; Alternatives 1, 2, 3, and 4.

These alternatives are not expected to have a contingency discharge.

Mitigation: *Alternative 5B.* No feasible mitigation has been identified.

Alternatives 1, 2, 3, 4, and 5B. No mitigation is proposed.

Impact: 6.9.1. Acrolein, chlorpyrifos, demeton, guthion (azinphos-methyl), malathion, parathion, and toxaphene. Will discharge scenario cause numeric-based criteria to be exceeded?

Analysis: *Laguna, Santa Rosa Creek, and Russian River*

Less than Significant; All Alternatives.

These substances are not detectable in reclaimed water but the detection limit is greater than the evaluation criterion. Recognized analytical methods that are routinely available to wastewater discharges do not provide sufficiently low detection limits to evaluate attainment of EPA's water quality standard. This impact is considered less than significant, but mitigation is required to assure that periodic monitoring for these substances is conducted.

Mitigation: *All Alternatives.*

2.5.1. Control program for pesticides

After Mitigation: *Less than Significant; All Alternatives.*

If these constituents are found to exceed water quality criteria, a source identification and control program shall be implemented by the City within 30 days to reduce or avoid impacts.

Impact: 6.9.2. Biostimulatory Substances - Adverse. Will the discharge component cause narrative-based criteria to be exceeded?

Analysis: ***Operation and Maintenance***

Laguna and Santa Rosa Creek

Significant; All Alternatives.

The discharge scenarios may cause up to a 134 percent increase in monthly average benthic algae biomass and up to a ten percent increase in monthly average planktonic algae biomass for one or more months of the year in the Laguna and/or Santa Rosa Creek (see Table 4.6-37).

Russian River

Significant; Alternatives 1, 5A, 5B.

These discharges may cause up to a 147% increase in monthly average benthic algae biomass and up to a 20% increase in monthly average planktonic algae biomass in the Russian River during one or more months of the year (see Table 4.6-38).

Less than Significant; Alternatives 2, 3, and 4.

Table 4.6-38 shows that the effect of Alternatives 2, 3 and 4 on algae in the Russian River is less than the point of significance (greater than 10% biomass increase).

Operation and Maintenance - Contingency Plan

Laguna and Santa Rosa Creek

Significant; Alternative 5.

Monthly average benthic algae biomass may increase by as much as 26% and monthly average planktonic algae biomass may increase by as much as 27% in the Laguna and/or Santa Rosa Creek during the period of contingency discharge. Contingency discharge does not increase the magnitude of the exceedence that will occur as a result of the design discharge alone. Table 4.6-39 summarizes the impact of contingency discharge on algal biomass relative to that of design discharge alone.

No Impact; Alternatives 1, 2, 3, and 4.

These alternatives do not have contingency discharge.

Table 4.6-37

Maximum Adverse Effects on Algae Biomass (as a measure of Biostimulatory Substances) from Discharge - Laguna and Santa Rosa Creek[1]

Discharge Scenarios	Benthic Algae	Planktonic Algae
Alt 1- No Action discharge	134%	3%
Alt 2 & 3 - 1% Design discharge	29%	10%
Alt 4 - Geysers discharge	40%	7%
Alt 5A - 20% Design discharge to the River	25%	10%
Alt 5B - 20% Design discharge to the Laguna	134%	2%

Source: *Water Quality Impacts Analysis*, Merritt Smith Consulting 1996r

Notes:
1. Value shown is for Santa Rosa Creek or the Laguna, whichever is higher

Table 4.6-38

Maximum Adverse Effects on Algae Biomass (as a measure of Biostimulatory Substances) from Discharge - Russian River

Discharge Scenarios	Benthic Algae	Planktonic Algae
Alt 1 - No Action discharge	69%	8%
Alt 2 & 3 - 1% Design discharge	<1%	<1%
Alt 4 - Geysers discharge	3%	<1%
Alt 5A - 20% Design discharge to the River		
River above the Laguna	147%	20%
River below the Laguna	47%	<1%
Alt 5B - 20% Design discharge to the Laguna	80%	12%

Source: *Water Quality Impacts Analysis*, Merritt Smith Consulting 1996r

Table 4.6-39

Maximum Adverse Effects on Algae Biomass from Contingency Discharge[1] - Laguna and Santa Rosa Creek

	Benthic Algae		Planktonic Algae	
Discharge Scenarios	**Design + Contingency Discharge**	**Design Discharge Alone[2]**	**Design + Contingency Discharge**	**Design Discharge Alone[2]**
Alt 5A - 20% Design discharge to the River	26%	26%	91%	91%
Alt 5B - 20% Design discharge to the Laguna	4%	5%	27%	35%

Source: *Water Quality Impacts Analysis*, Merritt Smith Consulting 1996r

Notes:
1. Value shown is for Santa Rosa Creek or the Laguna, whichever is higher
2. Values represent estimated impact in a very low flow year that will cause contingency discharge. The values in Table 4.6-37 represent estimated impact in years of less extreme flow conditions. Therefore, values in Table 4.6-37 and Table 4.6-39 are not necessarily the same.

Russian River

Significant; Alternative 5.

Monthly average benthic algae biomass may increase by as much as 22% in the Russian River during the period of contingency discharge. Monthly average planktonic algae biomass may increase by as much as 29% in the Laguna during the period of contingency discharge. Contingency discharge does not substantially increase the magnitude of the exceedence that will occur as a result of the design discharge alone. Table 4.6-40 summarizes the impact of contingency discharge on algal growth relative to that of design discharge alone. Table 4.6-40 addresses only 20% discharge scenarios because these are the only scenarios that include contingency discharge.

No Impact; Alternatives 1, 2, 3, and 4.

These alternatives do not have contingency discharge.

Table 4.6-40

Maximum Adverse Effects on Algae Biomass from Contingency Discharge - Russian River

	Benthic Algae		Planktonic Algae	
Discharge Scenarios	**Design + Contingency Discharge**	**Design Discharge Alone[1]**	**Design + Contingency Discharge**	**Design Discharge Alone[1]**
Alt 5A - 20% Design discharge to the River				
River above the Laguna	22%	22%	29%	25%
River below the Laguna	5%	6%	5%	6%
Alt 5B - 20% Design discharge to the Laguna	5%	6%	10%	13%

Source: *Water Quality Impacts Analysis*, Merritt Smith Consulting 1996r

1. Values represent estimated impact in a very low flow year that will cause contingency discharge. The values in Table 4.6-38 represent estimated impact in years of less extreme flow conditions. Therefore, values in Table 4.6-38 and Table 4.6-40 are not necessarily the same.

Mitigation: *All Alternatives.*

2.5.4. Discharge Operations.

After Mitigation: *Significant; Alternative 1.*

The No Action (No Project) Alternative by definition, does not include mitigation.

Significant after Mitigation; Alternatives 2 and 5.

The Mitigation Discharge Operating Scenario will reduce the frequency of significant adverse impacts of biostimulatory substances for all alternatives except the 1% discharge scenario. Mitigation increases the frequency of beneficial impacts of biostimulatory substances for all discharge scenarios except the No Action alternative (for which no mitigation is proposed). Secondary impacts of this mitigation measure will occur for turbidity, dissolved oxygen, and the Waste Reduction Strategy - some beneficial and some adverse. The following text describes the effectiveness of the Mitigation Discharge Operating Scenario.

Table 4.6-41 shows the number of exceedences of points of significance for adverse benthic algae, planktonic algae, turbidity, and dissolved oxygen impacts that are potentially caused by each discharge scenario expressed as a percentage of the total number of scenarios that have been analyzed. For example, the 1% design discharge scenario will cause exceedence of the benthic algae point of significance in 4 of 108 cases (4%). The number of scenarios equals creek segments times hydrologic conditions times 12 months per year.

Table 4.6-41 also shows the effect of the Mitigation Discharge Operating Scenario on the number of exceedences resulting from design discharges. Mitigation will not reduce significant impacts for the 1% discharge scenario. Therefore, mitigation is not recommended for the 1% discharge scenario. The mitigation that has been specified for the geysers, 20% Laguna, and 20% River design discharge scenarios will reduce, but not eliminate, significant impacts. Mitigation is not effective at reducing the frequency of adverse impacts on dissolved oxygen. In fact, the mitigation discharge operating scenario will cause a slight increase in the frequency of significant adverse dissolved oxygen impacts (see Table 4.6-41).

Table 4.6-41

Number of Significant Adverse Impacts of Project and Mitigation Operating Scenario (Discharge Impacts)

		Percent of Analyses with Significant Impacts							
		Benthic Algae		Planktonic Algae		Turbidity		Dissolved Oxygen	
Discharge Scenario	No.[1] of Analyses	Project	Mitig	Project	Mitig	Project	Mitig	Project	Mitig
Alt 1	108	45%	--	0%	--	0%	--	0%	--
Alts 2 & 3	108	4%	6%	1%	1%	0%	0%	0%	0%
Alt 4	108	9%	4%	0%	0%	0%	0%	0%	0%
Alt 5A	144	24%	11%	2%	1%	1%	0%	0%	0%
Alt 5B	108	46%	11%	1%	0%	0%	0%	1%	2%[2]

Source: *Water Quality Impacts Analysis*, Merritt Smith Consulting 1996r

Notes:
1. This column shows the number of scenarios that were analyzed using the evaluation approach described in this report (108 = 3 creek segments *x* 3 types of years *x* 12 months/year). Twelve months are evaluated instead of 7.5 discharge season months because of the potential for reclaimed water discharges to have a residual impact in summer after discharge ceases in May.
2. Decreases in dissolved oxygen concentration with mitigation as a result of decreases in oxygen-producing benthic algae.

No significant impacts are predicted from contingency discharge that are not also predicted from design discharge with one exception. The only exception is for contingency discharge with mitigation discharge operating scenario. In the case of Alternative 5B, contingency discharge with mitigation operations (Measure 2.5.4) is predicted to cause increases in the maximum ammonia concentration in one month of the year that exceed the point of significance .

Significant beneficial impacts of reclaimed water discharge scenarios have been identified for particular constituents in particular creek reaches and are summarized in Table 4.6-42. Table 4.6-42 summarizes the number of beneficial impacts of each discharge scenario with and without mitigation. The Mitigation Discharge Operating Scenario generally increases the number of significant beneficial impacts.

Table 4.6-43 illustrates the net impact of discharge scenarios on benthic algae, planktonic algae, turbidity and waste reduction strategy. Net impact is calculated by subtracting the percent of significant adverse impacts shown in Table 4.6-41 from the percent of significant beneficial impacts shown in Table 4.6-42. Thus, a positive value in Table 4.6-43 indicates more beneficial than adverse impacts on benthic algae, planktonic algae and turbidity. Table 4.6-43 shows that mitigation will provide a net beneficial impact for the discharge scenarios for which mitigation is proposed (Alternatives 4, 5A, 5B). Net impact can be so calculated only for benthic algae, planktonic algae, turbidity and waste reduction strategy because these are the only surface water quality evaluation criteria for which significant beneficial impacts could be identified.

Table 4.6-42

Number of Significant Beneficial Impacts of Project and Mitigation Discharge Operating Scenario

		Percent of Analyses with Significant Impacts							
		Benthic Algae		Planktonic Algae		Turbidity		Waste Reduction Strategy	
Discharge Scenario	No.[1] Analyses	Project	Mitig	Project	Mitig	Project	Mitig	Project	Mitig
Alt 1	108	0%		4%		4%		0%	
Alts 2 & 3	108	14%	14%	0%	0%	0%	0%	100%	100%
Alt 4	108	13%	12%	0%	0%	0%	0%	100%	100%
Alt 5A	144	9%	17%	12%	15%	8%	8%	100%	100%
Alt 5B	108	0%	16%	4%	2%	4%	0%	0%	0%

Source: *Water Quality Impacts Analysis*, Merritt Smith Consulting 1996R

[1] This column shows the number of scenarios that were analyzed using the evaluation approach described in this report (108 = 3 creek segments *x* 3 types of years *x* 12 months/year).

Table 4.6-43

Net Impact[1] of Project and Mitigation Discharge Operating Scenario [2]

		Percent of Analyses with Significant Impacts							
		Benthic Algae		Planktonic Algae		Turbidity		Waste Reduction Strategy	
Discharge Component	No. Analyses[3]	Project	Mitig	Project	Mitig	Project	Mitig	Project	Mitig
Alt 1	108	-45%		+4%		+4%		-100%	
Alts 2 & 3	108	+10%	+8%	-1%	-1%	0%	0%	+100%	+100%
Alt 4	108	+4%	+8%	0%	0%	0%	0%	+100%	+100%
Alt 5A	144	-15%	+6%	+10%	+14%	+7%	+8%	+100%	+100%
Alt 5B	108	-46%	+5%	+3%	+2%	+4%	0%	-100%	0%

Source: *Water Quality Impacts Analysis*, Merritt Smith Consulting 1996R

1. Values in this table represent the number (in percent of total analyses) of significant beneficial impacts minus the number of significant adverse impacts. Thus, a value greater than zero indicates more significant beneficial impacts than adverse impacts.
2. Dissolved oxygen not included in this table because no criteria for beneficial impact have been developed. Since beneficial dissolved oxygen impacts cannot be characterized, net dissolved oxygen impact cannot be calculated.
3. This column shows the maximum number of significant impacts that could be identified for benthic algae, planktonic algae and turbidity using the evaluation approach described in this report (108 = 3 creek segments *x* 3 types of years *x* 12 months/year). The maximum number of significant waste reduction strategy impacts is 1.

Impact: **6.9.2. Biostimulatory Substances - Beneficial. Will the discharge component result in beneficial impacts based on narrative based criteria?**

Analysis: *Operation and Maintenance*

Laguna and Santa Rosa Creek

Beneficial; All Alternatives.

Discharge scenarios may cause up to a 36% decrease in monthly average benthic algae biomass and up to a 32% decrease in monthly average planktonic algae biomass during one or more months of the year in the Laguna and/or Santa Rosa Creek (see Table 4.6-44).

Russian River

Beneficial; Alternatives 2, 3, 4, and 5A.

These discharge scenarios may cause up to a 23% decrease in monthly average benthic algae biomass and up to a 34% decrease in monthly average planktonic algae biomass in the Russian River during one or more months of the year (see Table 4.6-45).

Less than Significant, (Beneficial); Alternatives 1 and 5B.

These discharge scenarios will decrease monthly average benthic and planktonic algae biomass in the Russian River somewhat, but not as much as 10%, the point of significance.

Operation and Maintenance - Contingency Discharge

Laguna and Santa Rosa Creek and Russian River

Less than Significant (Beneficial); Alternatives 5.

Contingency discharge will not cause a significant beneficial impact on algae in the Laguna and/or Russian River.

No Impact; Alternatives 1, 2, 3, and 4.

These alternatives do not have contingency discharge.

Table 4.6-44

Maximum Beneficial Effects on Algae Biomass from Discharge - Laguna and Santa Rosa Creek[1]

Discharge Scenarios	Benthic Algae	Planktonic Algae
Alt 1- No Action discharge	<-1%	-27%
Alt 2 & 3 - 1% Design discharge	-36%	<-1%
Alt 4 - Geysers discharge	-23%	<-1%
Alt 5A - 20% Design discharge to the River	-33%	<-1%
Alt 5B - 20% Design discharge to the Laguna	-7%	-32%

Source: *Water Quality Impacts Analysis*, Merritt Smith Consulting 1996r

1. Value shown is for Santa Rosa Creek or the Laguna, whichever is highest

Table 4.6-45

Maximum Beneficial Effects on Algae Biomass
from Discharge - Russian River

Discharge Scenarios	Maximum Effect Relative to Existing Conditions Baseline	
	Benthic Algae	**Planktonic Algae**
Alt 1 - No Action discharge	<-1%	-2%
Alt 2 & 3 - 1% Design discharge	-20%	-7%
Alt 4 - Geysers discharge	-23%	-7%
Alt 5A - 20% Design discharge to the Russian River		
River above the Laguna	-3%	<-1%
River below the Laguna	-16%	-34%
Alt 5B - 20% Design discharge to the Laguna	<-1%	-2%

Source: *Water Quality Impacts Analysis*, Merritt Smith Consulting 1996r

Mitigation: *All Alternatives.* No mitigation is proposed. Mitigation operations that are proposed for adverse impacts on biostimulatory substances will increase the number of beneficial impacts.

Impact: 6.9.2. Turbidity - Adverse. Will the discharge component cause narrative-based criteria to be exceeded?

Analysis: ***Operation and Maintenance***

Laguna and Santa Rosa Creek

Less than Significant; All Alternatives.

The adverse impact of discharge on turbidity due to planktonic algae is predicted to be less than significant in the Laguna de Santa Rosa and Santa Rosa Creek for all discharge scenarios. The ranges of adverse impacts from discharge on turbidity due to planktonic algae with an existing conditions baseline are shown above in Table 4.6-37.

Russian River

Significant; Alternative 5A.

The adverse impact of discharge to the Russian River on turbidity due to planktonic algae may be significant in the Russian River above the confluence with the Laguna for a 20% design discharge to the River. The

range of adverse impacts on turbidity due to planktonic algae compared to an existing conditions baseline are shown above in Table 4.6-38.

Less than Significant; Alternatives 1, 2, 3, 4, and 5B.

The adverse impact of discharge on turbidity due to planktonic algae is predicted to be less than significant in the Russian River for all discharge scenarios, except that associated with Alternative 5A. The range of adverse impacts from discharge on turbidity due to planktonic algae are shown above in Table 4.6-39.

Operation and Maintenance - Contingency Plan

Laguna and Santa Rosa Creek

Significant; Alternative 5.

Planktonic algae biomass, and thus turbidity, may increase by as much as 27% in the Laguna during the period of contingency discharge. Contingency discharge does not increase the magnitude of the exceedence that will occur as a result of the normal discharge alone, as described in Table 4.6-39.

No Impact; Alternatives 1, 2, 3, and 4.

These alternatives do not have contingency discharge.

Russian River

Significant; Alternative 5A.

Planktonic algae biomass, and thus turbidity, may increase by as much as 29% in the Russian River during the period of contingency discharge. Contingency discharge slightly increases the magnitude of the exceedence that will occur as a result of the normal discharge alone, as described in Table 4.6-40.

Less than Significant; Alternative 5B.

The adverse impact of discharge on turbidity due to planktonic algae is predicted to be less than significant in the Russian River for Alternative 5B, as described in Table 4.6-40.

No Impact; Alternatives 1, 2, 3, and 4.

These alternatives do not have contingency discharge.

Mitigation: *Alternative 5.*

2.5.4. Discharge Operations

Alternative 1, 2, 3, and 4. No mitigation is proposed.

After Mitigation: *Significant after Mitigation; Alternative 5.*

The Mitigation Discharge Operating Scenario will eliminate significant adverse impacts from normal discharge scenarios (except Alt 2 & 3). This mitigation is effective at eliminating the significant turbidity impact of contingency discharge in the Russian River, but not the Laguna.

Impact: **6.9.2. Turbidity - beneficial. Will the discharge component result in beneficial impacts based on narrative based criteria?**

Analysis: ***Operation and Maintenance***

Laguna and Santa Rosa Creek

Beneficial. Alternatives 1 and 5B.

The beneficial impact of discharge on turbidity due to planktonic algae may be significant in the Laguna de Santa Rosa and/or Santa Rosa Creek. The ranges of beneficial impacts from discharge on turbidity due to planktonic algae with an existing conditions baseline are shown above in Table 4.6-44.

Less than Significant (Beneficial); Alternatives 2, 3, 4, and 5A.

These discharge scenarios will not cause a significant beneficial impact on turbidity in the Laguna and/or Santa Rosa Creek.

Russian River

Beneficial; Alternative 5A.

The beneficial impact of discharge on turbidity due to planktonic algae may be significant in Russian River. The ranges of beneficial impacts from discharge on turbidity due to planktonic algae with an existing conditions baseline are shown above in Table 4.6-45.

Less than Significant (Beneficial); Alternatives 1, 2, 3, 4, and 5B.

These discharge scenarios will not cause a significant beneficial impact on turbidity in the Russian River.

Operation and Maintenance - Contingency Plan.

Laguna and Santa Rosa Creek

Less than Significant (Beneficial); Alternative 5.

Contingency discharge will not cause a significant beneficial impact on turbidity in the Laguna and/or Santa Rosa Creek.

No Impact; Alternatives 1, 2, 3, and 4.

These alternatives not have contingency discharge.

Russian River

Less than Significant (Beneficial); Alternative 5.

Contingency discharge will not cause a significant beneficial impact on turbidity in the Russian River.

No Impact; Alternatives 1, 2, 3, and 4.

These alternatives do not have contingency discharge.

Mitigation: No mitigation is proposed.

Impact: 6.9.2. Waste Reduction Strategy - Total Nitrogen-Adverse. Will the discharge component cause narrative-based criteria to be exceeded?

Analysis: *Laguna and Santa Rosa Creek*

Significant; Alternatives 1 and 5B.

The Regional Board has established a goal for the Subregional System to reduce total nitrogen load in the Laguna de Santa Rosa by 159,000 pounds per year from their 1994 estimated load of 424,000 pounds per year. No Action discharge and 20% design discharge to the Laguna will increase the total nitrogen load by 252,000 and 223,000 pounds per year, respectively, and thus not attain the load reduction goal (Table 4.6-46). If the 20% design discharge to the Laguna will be implemented, the Subregional System will need to reduce the total nitrogen load by 159,000 + 223,000 pounds per year, or 382,000 pounds per year, to be in attainment of the total nitrogen waste reduction goal.

Table 4.6-46

Effects of Discharge on Total Nitrogen Load Reduction - Laguna de Santa Rosa

Discharge Scenario	Total Nitrogen
Alt 1 - No Action discharge	+252,000 lbs/year
Alt 2&3 - 1% Design discharge	-329,000 lbs/year
Alt 4 - Geysers discharge	-361,000 lbs/year
Alt 5A - 20% Design discharge to the Russian River	-352,000 lbs/year
Alt 5B - 20% Design discharge to the Laguna	+223,000 lbs/year

Source: *Water Quality Impacts Analysis*, Merritt Smith Consulting 1996r

Less than Significant; Alternatives 2, 3, 4, and 5A.

These alternatives will reduce the estimated annual total nitrogen load to the Laguna more than that necessary to meet the point of the significance,

which is 159,000 pounds per year (see Table 4.6-46). Therefore, the impact of these alternatives is considered to be less than significant.

Russian River

Not Applicable. The Waste Load Reduction Strategy - Total Nitrogen is not applicable to the Russian River.

Mitigation: *Alternative 5B.*

2.5.7 Total and Ammonia Nitrogen Source Control Program

Alternatives 2, 3, 4, and 5A. No mitigation is proposed.

After Mitigation: *Significant; Alternative 1.*

The No Action (No Project) alternative, by definition, does not include mitigation.

Less than Significant after Mitigation; Alternative 5B.

Nitrogen sources to the Laguna are known (North Coast Regional Board 1995), and the technology to mitigate their potential impacts has been demonstrated locally (Gold Ridge RCD 1995). With implementation of the source control programs, nitrogen sources will be reduced as follows:

20% Laguna design discharge: The total nitrogen load will be reduced by 382,000 pounds per year.

Impact: 6.9.2. Waste Reduction Strategy - Total Nitrogen - Beneficial. Will the discharge component result in beneficial impacts based on narrative criteria?

Analysis: *Laguna and Santa Rosa Creek*

Beneficial; Alternatives 2, 3, 4, and 5A.

These discharge scenarios are predicted to reduce the nitrogen load to the Laguna by more than 159,000 lbs/year (Table 4.6-46) because discharge to the Laguna will be reduced from existing conditions..

Less than Significant (Beneficial); Alternatives 1 and 5B.

These discharge scenarios are not predicted to reduce the nitrogen load to the Laguna by more than 159,000 lbs/year (see Impact 6.9.2 Waste Reduction Strategy - Total Nitrogen - Adverse) because reclaimed water discharge to the Laguna will not be reduced by these alternatives.

Russian River

No Impact; All Alternatives.

The Waste Load Reduction Strategy - Total Nitrogen is not applicable to the Russian River.

Mitigation: *All Alternatives.* No mitigation is proposed.

Impact: 6.9.2. Waste Reduction Strategy - Ammonia Nitrogen - Adverse. Will the discharge component cause narrative-based criteria to be exceeded?

Analysis: *Laguna and Santa Rosa Creek*

Significant; Alternatives 1 and 5B.

The Regional Board has established a goal for the Subregional System to reduce ammonia-nitrogen load in the Laguna de Santa Rosa by 21,500 pounds per year from their 1994 estimate of 56,100 pounds per year. These discharge scenarios will not attain the load reduction goal (Table 4.6-47). The 20% Laguna design discharge represents increased annual volume of reclaimed water discharge relative to existing conditions, yet the annual ammonia load is expected to decrease. This is because the concentration of ammonia in storage ponds (which is the source of reclaimed water that is discharged) has decreased relative to the concentration upon which the Regional Board's 1994 estimate of 56,100 pounds per year is based (Merritt Smith Consulting 1996r).

Table 4.6-47

Effects on Ammonia-Nitrogen Load Reduction from Discharge - Laguna de Santa Rosa

Discharge Scenarios	Ammonia-Nitrogen
Alt 1 - No Action discharge	-16,800 lbs/year
Alt 2&3 - 1% Design discharge	-51,000 lbs/year
Alt 4 - Geysers discharge	-52,900 lbs/year
Alt 5A - 20% Design discharge to the Russian River	-52,300 lbs/year
Alt 5B - 20% Design discharge to the Laguna	-18,500 lbs/year

Source: *Water Quality Impacts Analysis*, Merritt Smith Consulting 1996r

The Regional Board established the ammonia reduction goals for each ammonia source such that the ammonia water quality objective for aquatic life protection will be met. The ammonia load reduction goal is the basis of the significance evaluation criterion for ammonia in the Laguna. Nonetheless, reclaimed water discharge will affect the concentration of ammonia in the Laguna and Santa Rosa Creek, as described in Table 4.6-48. The estimates of discharge scenario impacts on ammonia concentration are not evaluated for significance, but are provided to more

fully describe potential Project impacts. Table 4.6-48 shows that the maximum ammonia-nitrogen concentration is expected to increase despite the reduced ammonia load indicated in Table 4.6-47. This is because the maximum ammonia concentration increase resulting from Project alternatives will occur as a result of discharge at time when the 1000 cfs restriction limits reclaimed water discharge under the existing condition.

Table 4.6-48

Effects on Ammonia-Nitrogen Concentration
Laguna de Santa Rosa from Discharge[1] - Laguna de Santa Rosa

Discharge Scenarios	Percent Change in Concentration
Alt 1 - No Action discharge	+636%
Alt 2&3 - 1% Design discharge	+<5%
Alt 4 - Geysers discharge	+66 %
Alt 5A - 20% Design discharge to the Russian River (upper River)	+<5%
Alt 5B - 20% Design discharge to the Laguna	+692%

Source: *Water Quality Impacts Analysis* Merritt Smith Consulting 1996r

[1] value shown is for Santa Rosa Creek or the Laguna, whichever is higher

Less than Significant; Alternatives 2, 3, 4, and 5A.

Table 4.6-47 shows that the ammonia load decrease resulting from Alternatives 2, 3, 4, and 5A is greater than the point of signficance, which is a 21,500 pounds per year decrease. Therefore, the adverse impact is considered to be less than significant.

Russian River

Not Applicable. The Waste Load Reduction Strategy - Ammonia-Nitrogen is not applicable to the Russian River.

Mitigation: *Alternative 5B.*

2.5.6 Total and Ammonia Nitrogen Source Control Program

Alternative 2, 3, 4, and 5A. No mitigation is proposed.

After Mitigation: *Significant after Mitigation; Alternative 1.*

The No Action alternative, by definition, does not include mitigation.

Less than Significant after Mitigation; Alternative 5B.

The sources of nitrogen in the Laguna are known (North Coast Regional Board 1995), and the technology to mitigate their potential impacts has been demonstrated locally (Gold Ridge RCD 1995). With implementation of the source control programs, nitrogen sources will be reduced as follows:

20% Laguna design discharge: The ammonia-nitrogen load will be reduced by 3,000 pounds per year.

Impact: **6.9.2. Waste Reduction Strategy. Ammonia Nitrogen. Beneficial. Will the discharge component result in beneficial impacts based on narrative criteria?**

Analysis: *Laguna and Santa Rosa Creek*

Beneficial; Alternatives 2, 3, 4, and 5A.

These discharge scenarios are predicted to reduce the nitrogen load to the Laguna by more than 21,500 lbs/year (Table 4.6-47).

Less than Significant; Alternatives 1 and 5B.

These discharge scenarios are predicted to reduce the nitrogen load to the Laguna by less than 21,500 lbs/year (Table 4.6-47).

Russian River

Not Applicable. The Waste Load Reduction Strategy - Nitrogen is not applicable to the Russian River.

Mitigation: No mitigation is needed.

Impact: **6.9.2. Toxicity (lethal effects). Will the discharge component cause narrative-based criteria to be exceeded.**

Analysis: ***Operation and Maintenance***

Laguna and Santa Rosa Creek

Significant; Alternatives 1 and 5B.

Lethal toxicity was found once in 11 tests, or in 9% of the tests (Merritt Smith Consulting 1996l), and the lowest, or worst-case concentration of reclaimed water at which no observable effect occurred (NOEC) was 25%. Table 4.6-49 shows the frequency of days that reclaimed water concentration will exceed 25% (the worst-case no-effects concentration) in Santa Rosa Creek (section of Laguna system subject to highest concentrations) using output of the water quality model as described in *Russian River Water Quality Model* Technical Report, (Resource Management Associates 1996b). These frequencies of potentially toxic concentrations are then multiplied by the worst-case toxicity frequency (9%), to give the expected occurrence of toxic conditions in Santa Rosa

Creek. These calculations are given for a dry year, an average year, and a wet year. The impact is considered significant if the frequency that toxic conditions will occur in the receiving water is greater for a discharge component than for existing conditions. Although Table 4.6-49 addresses Santa Rosa Creek only, the concentration of reclaimed water in the Laguna will also exceed 25% for the 20% Laguna design discharge and No Action discharge.

Table 4.6-49

Calculated Probability of Toxic Conditions In Santa Rosa Creek Resulting From Discharge

Discharge Component	Days Reclaimed Water Concentration is Greater than 25%[1]	Frequency of Lethally Toxic Concentration[2]
Alt 1 - No Action Discharge	88.4	7.9%
Alt 2, 3 - 1% Design Discharge	0	0
Alt 4 - Geysers Discharge	0	0
Alt 5A - 20% Design Discharge to Russian River	0	0
Alt 5B - 20% Design Discharge to Laguna	93.7	8.4%
Existing Conditions	67.6	6.1%

1. Values in this column represent the frequency (percentage) of days that the daily average reclaimed water concentration in Santa Rosa Creek will exceed 25%. This frequency was estimated using water quality model output. Model is described in the *Russian River Water Quality Model* Technical Report, (Resource Management Associates 1996b). Model output is graphically presented in the *Water Quality Impacts Analysis* Technical Report, (Merritt Smith Consulting 1996r). 25% reclaimed water concentration was selected because it represents the lowest no effects concentration of the worst case lethal toxicity episode.
2. Values in this column represent the percentage of days in the discharge season that toxic conditions may occur in Santa Rosa Creek. These values are calculated by multiplying the frequencies of reclaimed water concentrations over 25% (which is the worst-case NOEC) by 1/11, or 0.09 (which is the proportion of fish toxicity tests which resulted in lethal toxicity), as reported in the *Reclaimed Water Quality Update* Technical Report, (Merritt Smith Consulting 1996l).

Less than Significant; Alternatives 2, 3, 4, and 5A.

These discharge scenarios will not produce lethal toxicity in the Laguna and/or Santa Rosa Creek (see Table 4.6-49).

Russian River

Less than Significant; All Alternatives.

Discharge scenarios are not predicted to produce lethal toxicity in the Russian River.

Operation and Maintenance - Contingency Plan

Laguna and Santa Rosa Creek

Significant; Alternative 5B.

Contingency discharge to the Laguna is predicted to produce lethal toxicity in the Laguna and/or Santa Rosa Creek at a frequency similar to design discharge (see Table 4.6-49).

Less than Significant; Alternative 5A.

Contingency discharge to the Russian River is predicted to produce lethal toxicity in the Laguna and/or Santa Rosa Creek at a frequency similar to design discharge (see Table 4.6-49).

No Impact; Alternatives 1, 2, 3, and 4.

These alternatives do not have contingency discharge.

Russian River

Less than Significant; Alternative 5.

Contingency discharge is not predicted to produce lethal toxicity in the Russian River.

No Impact; Alternatives 1, 2, 3, and 4.

These alternatives do not have contingency discharge.

Mitigation: *Alternative 5B.*

2.5.8 Toxicity Control Program.

Alternatives 2, 3, 4, and 5A. No mitigation is proposed.

After Mitigation: *Significant; Alternative 1.*

The No Action alternative, by definition, does not include mitigation.

Less than Significant after Mitigation; Alternative 5B.

This mitigation program shall consist of increased monitoring, toxicity identification (TIE) and reduction (TRE) and is recommended regardless of which alternative is implemented. The TIE/TRE process, developed by EPA, has been proven to successfully identify and control toxicity-causing constituents in effluents exhibiting consistent toxicity. Therefore, this mitigation measure is considered to be effective.

Impact: 6.9.3. Will the discharge component impact special sites?

Analysis: *No Impact; All Alternatives.*

No special sites addressed with this evaluation criterion are located in the Russian River or Santa Rosa Plain. The discharge component will not affect watersheds with special sites in West County.

Mitigation: No mitigation is needed.

Impact: 6.9.4. Will the discharge component cause sediment quality criteria to be exceeded?

Analysis: *Less than Significant; All Alternatives.*

Evaluation criteria with points of significance have been established for 5 constituents: acenaphthene, dieldrin, endrin, fluoranthene, and phenanthrene. The discharge does not contain any of these constituents in detectable amounts. Modeling of the impacts of the discharge on sediment (assuming that these constituents are present in reclaimed water and receiving water at a concentration equal to the analytical detection limit) indicates that the point of significance will not be exceeded for any of the discharge rate scenarios being considered. Thus, this impact is considered to be less than significant.

Mitigation: No mitigation is proposed.

CUMULATIVE IMPACTS

Storage Reservoirs and Agricultural Irrigation

Sebastopol

The Project will not affect water quality in the surface waters of the Sebastopol area. No cumulative projects were identified that will cause the Project impact to change. Thus, no impacts of cumulative projects on surface water quality are expected to occur.

West County

The Stemple Creek/Estero de San Antonio Watershed Enhancement Plan (Prunuske Chatham 1994) is the one cumulative project that has been identified which may have a nexus with surface water quality impacts potentially resulting from West County irrigation and storage. The Stemple Creek/Estero de San Antonio Watershed Enhancement Plan recommends measures to conserve and improve the natural resources of the watershed, while maintaining the agricultural economy. Recommended measures include the following:

- Encourage public involvement
- Reduce pollutants to Stemple Creek and the Estero
- Restore the riparian corridor

These measures are consistent with the Long-Term Project description and mitigation (see Section 2.2) and, as such, will tend to reduce impacts of the West County irrigation and storage components. However, the measures recommended in the Stemple Creek/Estero de San Antonio Watershed Enhancement Plan will result in changes to the flow and quality of Stemple Creek that will cause water quality changes in Estero de San Antonio. Under the evaluation criteria established to evaluate the significance of potential impacts in the Esteros, the impact of the Stemple Creek/Estero de San Antonio Watershed Enhancement Plan, Santa Rosa's irrigation and storage components, or both will be considered significant. The Stemple Creek/Estero de San Antonio Watershed Enhancement Plan was developed to provide a beneficial impact on Estero de San Antonio.

South County

Cumulative projects with a potential nexus with water quality impacts of Project components are shown in Table 4.6-50. Potential impacts of cumulative projects (projects listed in Table 4.6-50) plus irrigation and storage components of the Long-Term Project on surface water quality are evaluated below.

Tolay Creek. As noted in Section 7.1.1 of the *Water Quality Impacts Analysis* technical report (Merritt Smith Consulting 1996r), obstructions in the Tolay Creek channel are expected to limit the effect of the Project to Tolay Creek above Highway 121. These obstructions will not be eliminated by the cumulative projects cited in Table 4.6-50. The cumulative projects cited in Table 4.6-50 will enhance tidal circulation in the slough downstream of the obstructions. Thus, the impact of cumulative projects is considered to be less than significant.

Petaluma River. The Petaluma Wastewater Facilities Project has a potential water quality nexus with Project irrigation in the Petaluma watershed. Chapter 2 of the *Petaluma Wastewater Treatment and Storage Facilities Project* Draft EIR 1994 indicates that Petaluma's wastewater discharge into the Petaluma River will have similar quality but less quantity (due to increased storage and irrigation) than current discharge. Any impacts on the Petaluma River of future Petaluma discharge will be reduced from current impacts. The concentration of some metals in undiluted Petaluma wastewater exceeds applicable water quality criteria (see Table 4.6-20). These criteria may also be exceeded in the Petaluma River near Petaluma's outfall. With the exception of copper, the concentrations of detectable constituents in Santa Rosa's reclaimed water and in ditch water (estimated concentration) from Bay Flats irrigation are less than the applicable points of significance. The estimated concentration of copper in ditch water from bay flats Long-Term Project irrigation (11.8 mg/l) is less than the concentration of copper in Petaluma's wastewater (20 mg/L - see Table 4.6-20). Therefore, discharge of Bay Flats irrigation water could only lessen any impacts of Petaluma's discharge. Thus, the Project cannot cause an exceedence, or cause the magnitude of an existing exceedence to increase, despite any impacts of cumulative projects on water quality and cumulative projects impact is considered to be less than significant.

Table 4.6-50

Summary of Cumulative Projects With Potential Water Quality Nexus in the South County Area

Type of Project	Project Title	Location	Reporting Agency	Watershed	Assessment	To Be Considered in Cumulative Impacts Evaluation?
Habitat Restoration/ Environmental Mitigation Project	Watershed restoration project	Tolay Creek	U.S. Department of Agriculture; Natural Resources Conservation Service	Tolay Creek	Project will enhance tidal exchange and tend to reduce any impacts of Subreg. System Project impacts	Yes
Habitat Restoration/ Environmental Mitigation Project	Environmental Mitigation	Route 121, Hwy. 37 to Tolay Green Bridge	Caltrans	Tolay Creek	Project will enhance tidal exchange and tend to reduce any impacts of Subreg. System Project impacts	Yes
Changes in Wastewater Discharges	Petaluma Wastewater Facilities Project	Petaluma River	City of Petaluma	Petaluma River	The Project will reduce the quantity of wastewater discharged to the Petaluma River. Potential effects of this projects on flow and water quality is evaluated for cumulative impacts	Yes

Source: Merritt Smith Consulting 1996

Geysers Steamfield

The Subregional System's geysers injection alternative is not expected to affect surface water quality in the geysers area, and no planned projects with a nexus to surface water quality have been identified. Thus, no cumulative impacts on surface water quality are expected to occur.

Discharge

Identification of Projects with the Potential for Cumulative Impacts

A list of projects in Sonoma County with the potential to interrelate with Long-Term Project impacts is provided as the Cumulative Projects List (Appendix D-31).

Proposed projects with a potential nexus with water quality impacts of Subregional System Project components are shown in Table 4.6-51. Proposed projects were selected (and included in Table 4.6-51) that:

- Potentially involve discharge.
- Are directly adjacent to waterways and thus could affect aquatic habitat and, thereby, water quality.

Projects involving diversions (reduction in Russian River flow) located above the Sonoma County Water Agency intakes are already factored into the analysis of design discharge, because the River flows used to estimate Subregional System Project effects are based on Sonoma County Water Agency estimate of future diversions. No water quality impacts are expected from the new intakes other than those which might be flow related, and any such impacts have already been included in the analysis.

Table 4.6-51

Summary of Cumulative Projects With Potential Water Quality Nexus in the Russian River Watershed

Type of Project	Project Title	Location	Reporting Agency	Water-shed	Assessment	Considered in Cumulative Impacts Evaluation?
Commercial Development Project	SYAR Industries-Terrace Pit Mining	Westside Road	Sonoma County, Corps	RR	River riparian area not affected, water quality not affected because Project located away from River	No
Commercial Development Project	Kaiser Sand & Gravel - Terrace Gravel Pit Reclamation	Sonoma County	Sonoma County, Corps	RR	Process plant relocation project, no aquatic habitat impacts	No
Commercial Development Project	Dewitt Sand and Gravel-Gravel Extraction Operations along the Russian River	Sonoma County	Corps	RR	Gravel skimming proposed, which is an existing practice. Project will not affect water quality or riparian habitat. Governed by County ARM.	No
Drainage Project	Russian River Breaching - Obstruction Removal and Sandbar Clearing	Jenner, Sonoma County	Sonoma County Public Works, Corps	RR	Not a new Project, Sandbar clearing is part of existing condition	No
Drainage Project	Prokopakis Irrigation Users	Guerneville Rd.	Corps of Engineers	RR	Project involves installing wells to evaluated groundwater effects of Subregional System irrigation.	No
Drainage Project	Silt Removal Water Storage Pond	Santa Rosa Creek	City of Santa Rosa Public Works, Corps	RR	Silt removal from channel on south side of Delta Pond. Not directly connected to Laguna or SR Ck	No

Table 4.6-51

Summary of Cumulative Projects With Potential Water Quality Nexus in the Russian River Watershed

Type of Project	Project Title	Location	Reporting Agency	Watershed	Assessment	Considered in Cumulative Impacts Evaluation?
Habitat Restoration/ Environmental Mitigation Project	Laguna Restoration Project of Braided Channels, Smith Property	Laguna de Santa Rosa	Dept. of Fish and Game	RR	Implementation unlikely	No
Habitat Restoration/ Environmental Mitigation Project	Laguna Restoration Project	Laguna de Santa Rosa	Dept. of Fish and Game	RR	Implementation unlikely	No
Water System Projects	New wells (9) at Wohler Aquifer Site	Near Wohler Pumping Plant on Wohler Rd, east of the Russian River	Sonoma County Water Agency	RR	No water quality impacts of construction. Impact of wells on flow is already included in analysis	No
Water System Projects	New Russian River Well Field	Between Mirabel Site and Wohler Road north of Russian River	Sonoma County Water Agency	RR	No water quality impacts of construction. Impact of wells on flow is already included in analysis	No
Water System Projects	Laguna de Santa Rosa Widening and Revegetation	From 1000' west of Stony Point Rd to Hinebaugh Creek Channel	Sonoma County Water Agency	RR	Project is located upstream of waters affected by the Subregional System Project. Downstream impact of SCWA project on water quality will be minor.	No

Table 4.6-51

Summary of Cumulative Projects With Potential Water Quality Nexus in the Russian River Watershed

Type of Project	Project Title	Location	Reporting Agency	Water-shed	Assessment	Considered in Cumulative Impacts Evaluation?
Water System Projects	Potter Valley Project	Mendocino and Lake Counties	Sonoma County Water Agency	RR	This Project potentially affects River flow, and is thus already factored into analysis	No
Water System Projects	Russian River Estuary Management Plan	Russian River from Duncans Mills to Jenner	Sonoma County Water Agency	RR	This Project potentially affects River flow, and is thus already factored into analysis	No
-	Waste Load Reduction	Laguna	RWQCB, City of Santa Rosa	RR	This Project involves reducing the total and ammonia nitrogen loads to the Laguna such that the dissolved oxygen and ammonia objectives are attained.	Yes
Increased Wastewater Discharges	-	Russian River, Laguna	Ukiah, Cloverdale, Healdsburg, Windsor, Forestville, Graton, Guerneville, Occidental	RR	The potential effect of these projects on flow and water quality is evaluated for cumulative impacts	Yes

Source: Merritt Smith Consulting 1996

Projects Eliminated From Further Evaluation

Many of the projects in the Appendix D-31 list could, if implemented, affect the quality and quantity of wastewater discharges and stormwater runoff. Each of these potential situations is considered below.

Wastewater Quality

The general plans in the cumulative projects area identify increased residential and commercial/industrial development in the Long-Term Project area and other wastewater system service areas. This development could affect the quality of wastewater produced were it not for federal pretreatment regulations (40 CFR 400-424) that require publicly-owned treatment works (POTWs) to prevent commercial/industrial development from adversely affecting effluent quality. Reclaimed water quality is thus controlled by residential inputs, and no change in residential sewage effluent quality will be expected due to future growth. Some of the smaller jurisdictions in the Long-Term Project area may not have pretreatment programs, but the wastewater from any such jurisdictions is assumed to have an insignificant commercial/ industrial component. Pretreatment regulations dictate that a POTW implement a pretreatment program when commercial/industrial sources that potentially affect effluent quality are being served by the POTW. Therefore, future changes in wastewater quality due to commercial/industrial development are assumed to be insignificant and are not evaluated further.

Wastewater Quantity

Cumulative projects could increase the quantity of wastewater discharged to surface waters in the Long-Term Project area. Wastewater discharges occur in the Russian River and Petaluma River basins. The following discussion shows why cumulative impacts do not need to be evaluated for most water quality constituents, except those that affect nutrients/algae/ dissolved oxygen in the Russian River and possibly in the Petaluma River.

Cumulative impacts of other (non-Project) reclaimed water irrigation projects and septic system projects will not be evaluated for reasons described as follows:

Irrigation Projects. Such projects are assumed to have no impact on surface water quality. This assumption is based on the expectation that strict irrigation management requirements that are similar to those imposed by the Regional Board on the Subregional System will be imposed on future reclamation systems. With strict irrigation management requirements in place, future irrigation projects are not expected to affect surface waters.

Septic Systems. New septic systems will not be evaluated because they are assumed to have no impact on surface water quality. This assumption is based on the understanding that existing failed systems adversely affect surface water

quality because they were constructed close to waterways, and current regulations prevent siting of systems in locations where surface water quality will be affected. The number of failed existing septic systems and their impacts are assumed to be the same in the future as in the present. Therefore, the cumulative impacts analysis will not consider existing septic system impacts. The impacts of existing septic systems have been included in Subregional System Project impacts relative to the existing condition.

Stormwater Quality

Land development can increase the concentration of water quality constituents in stormwater runoff from the site. Stormwater runoff from some of the cumulative projects could, in turn, affect the quality of the Russian River, the Laguna de Santa Rosa, and other waterways. However, such cumulative projects are not expected to result in any significant Subregional System reclaimed water discharge impacts that were not identified in the analysis of impacts of the discharge alternatives alone. This is because the significant water quality impacts of the Project's reclaimed water discharge components that have been identified will occur during dry weather, low flow conditions (when relatively little dilution of reclaimed water occurs) and usually involve constituents that are not associated with stormwater runoff. Dilution of reclaimed water during storm events is much greater than during dry weather.

Cumulative Impacts Evaluation Approach

The cumulative impacts evaluation approach for the Santa Rosa Plain and Russian River areas are described below.

Potential impacts of reclaimed water discharge alternatives have been evaluated using two methods as follows:

- Estimates of dilution
- Using a water quality model to simulate biological interactions with reclaimed water constituents.

Dilution Model

The method for identifying impacts of design discharge with respect to many of the numeric-based evaluation criteria involved using estimates of reclaimed water dilution (95^{th} percentile reclaimed water concentration in a dry year), constituent concentration in reclaimed water, and the background constituent concentration in Santa Rosa Creek/Laguna to estimate the potential Project impact on constituent concentration. None of the design discharge rates was predicted to cause numeric points of significance to be exceeded for any constituents in reclaimed water except conductivity and cyanide. No criterion for significance exists for conductivity in the Laguna or Santa Rosa Creek. No cumulative projects have

been identified that will change background water quality conditions in the Laguna or Santa Rosa Creek, which are not affected by any wastewater discharges except that of the Subregional System and the City of Windsor. The City of Windsor discharges to the Laguna at Trenton Healdsburg Road. Increased total annual volume was evaluated, but no changes in its maximum discharge rate (because of Basin Plan restrictions) or quality (because of pretreatment regulations) are included in cumulative projects. Thus, the Project cannot cause an exceedence, or cause the magnitude of an existing exceedence (e.g. cyanide) to increase, despite any impacts of cumulative projects on water quality. Therefore, the cumulative impacts analysis will not address any of the constituents evaluated using the dilution method, other than conductivity in the Russian River.

The Project design discharge alternatives caused an exceedence of the conductivity point of significance in the Russian River above the Laguna, and conductivity in the Russian River is potentially affected by other discharges. The potential for cumulative projects to cause significant conductivity impacts in the River above and below the Laguna has been evaluated as described below.

Conductivity Evaluation above the Laguna

For purposes of this analysis, the incremental (cumulative Project) discharge from other communities was assumed not to lower the baseline conductivity in the Russian River above the Laguna, and will probably cause conductivity to increase. Since the 20% design discharge to the Russian River above the Laguna is estimated to cause a significant impact on conductivity, this impact of cumulative projects will also be considered significant.

Conductivity Evaluation below the Laguna

The impact of cumulative projects on conductivity in the Russian River below the Laguna was assessed by assuming that all the conductivity in the River is due to reclaimed water (a conservative approach). The flow in the River in each month of an average year (1961) was obtained from the monthly water balance model, and the proportion of the monthly flow that will be due to the incremental flow from non-Santa Rosa reclaimed water discharge was determined then multiplied by the existing monthly conductivity to get a predicted monthly increase in conductivity due to non-Santa Rosa reclaimed water discharge. The estimated incremental monthly conductivity value was added to the monthly conductivity values predicted for a 20% design discharge to the Laguna and 20% design discharge to the River (see Table 4.6-12) to estimate monthly conductivity under the cumulative project condition. If the median of twelve monthly average conductivity values exceeded the point of significance, then the impact will be considered to be significant.

Toxicity

A 20% design discharge to the Laguna and discharge related to the No Project alternative will cause an increase in the frequency of toxicity in the Laguna and Santa Rosa Creek. The only cumulative project identified for the Laguna and Santa Rosa Creek is reduction of total nitrogen and ammonia to the Laguna. Reduction of ammonia and nitrogen will not cause an increase in toxicity and, since the toxicity was found in effluent alone (not receiving water), reduction of ammonia and nitrogen will not cause a decrease in toxicity. Therefore, the impact of cumulative projects was not evaluated for toxicity in the Laguna and Santa Rosa Creek since it will be the same as the impacts predicted for design discharge.

Toxicity in the Russian River from all design discharge rates that were evaluated is predicted to be less than significant. The toxicity of discharges from other communities discharging into the Russian River is not known. However, since all other dischargers must adhere to a regulatory limit of zero acute and chronic toxicity in their discharge, it is assumed that there will be no toxicity. Therefore, the impact of cumulative projects on toxicity will be less than significant.

Water Quality Model

The effect of Project discharge is potentially affected by the changes in other wastewater discharges to the Laguna and Russian River. The Regional Board estimated the change in the discharges of other permitted discharges in the Russian River basin, and these are summarized Table 4.6-52. The flows and effluent quality described therein are being used to evaluate for cumulative impacts. The Regional Board's flow estimates are based on the general plan growth as of the time of the Regional Board's assessment (1994). Since then, Ukiah and Windsor have proposed general plan amendments that will further increase reclaimed water flows from existing conditions.

Table 4.6-52

Estimated Future Wastewater Discharges to the Russian River Basin

	Average Dry Weather Flow (mgd)				
Community	**Regional Board Flow Estimate[1]**	**Additional Flow Due to Growth[2]**	**Total Future Flow[3]**	**Existing Flow[4]**	**Incremental Flow[5]**
Ukiah	3.4	0.14	3.54	2.4	1.14
Cloverdale	2.00	0	2	0.5	1.5
Healdsburg	1.80	0	1.8	1.0	0.8

Table 4.6-52

Estimated Future Wastewater Discharges to the Russian River Basin

	Average Dry Weather Flow (mgd)				
Community	Regional Board Flow Estimate[1]	Additional Flow Due to Growth[2]	Total Future Flow[3]	Existing Flow[4]	Incremental Flow[5]
Windsor	2.7	2.1	4.8	1.1	3.7
Forestville	0.12	0	0.12	0.05	0.07
Graton	0.14	0	0.14	0.08	0.06
Guerneville	0.71	0	0.71	0.35	0.36
Occidental	0.05	0	0.05	0.02	0.03

[1] General Plan projections reported in Regional Board (1994)
[2] Based on proposed general plan changes since 1994
[3] Sum of two column to the left
[4] Based on reports submitted by dischargers to Regional Board, also summarized in Table 4.6-9
[5] Flow used for cumulative impacts analysis

The North Coast Regional Board has established total nitrogen and ammonia load reduction goals for the Laguna watershed to improve Laguna water quality (North Coast Regional Board 1995). The Regional Board has established load reduction goals for urban nonpoint source discharges, agriculture and the Subregional System. Attainment of the load reduction goals for urban nonpoint source discharges and agriculture are considered a cumulative project for this analysis. The total nitrogen load reduction goals for urban and agriculture are 23,000 and 132, 000 pounds per year, respectively. The ammonia nitrogen load reduction goals for urban and agricultural sources are 2,300 and 23,000 pounds per year, respectively. The attainment of the load reduction goal for the Subregional System was not included in the cumulative project because attainment of the Subregional System goal was evaluated in the Project analysis.

The nutrient/algae/dissolved oxygen interactions that occur in the Laguna and Russian River as a result of reclaimed water discharges and other discharges and as a result of non-Subregional System waste load reductions were evaluated with the water quality model that was used to evaluate design discharge (Merritt Smith Consulting 1996r). The same approach was used to evaluate cumulative projects impacts with the following exceptions:

- Cumulative project impacts were evaluated for a normal hydrological year (1961). Design Project discharges were evaluated in a dry (1976), normal (1961) and wet (1982) year simulation.

- Cumulative project impacts were evaluated for significance relative to existing conditions, and the potential cumulative impacts are also described relative to impacts of design discharge.

- The potential impacts of cumulative discharge on benthic algae, planktonic algae, dissolved oxygen, and ammonia in Santa Rosa Creek, the Laguna de Santa Rosa, and the Russian River were evaluated as for design discharge. Cumulative project impacts on temperature, however, were not evaluated using the model. The temperature point of significance is that a 5 °F increase in monthly average temperature will be considered significant. The greatest effect of the Santa Rosa discharge on receiving water temperature occurs in Santa Rosa Creek, and any downstream effects attenuate rapidly (see Figure 4-17 of the *Water Quality Impacts Analysis* technical report) (Merritt Smith Consulting 1996r). None of the cumulative projects are expected to affect temperature. Thus, since no significant impacts of design discharge components will occur (see Figure 4-17 of the *Water Quality Impacts Analysis* technical report) (Merritt Smith Consulting 1996r), no significant impacts of the cumulative projects will occur either.

Results of Cumulative Impacts Assessment for Discharge

Significant adverse and beneficial impacts of cumulative projects (projects listed in Table 4.6-50 plus the Project) are summarized in Tables 4.6-53 through 4.6-55. Table 4.6-53 presents the frequency of adverse impacts (as a percentage of the total possible adverse impacts) of cumulative projects and cumulative projects plus mitigation for biostimulatory substances. Table 4.6-54 presents the frequency of beneficial impacts (as a percentage of the total possible beneficial impacts) of cumulative projects and cumulative projects plus mitigation for biostimulatory substances. Table 4.6-55 presents the net number of impacts (the number of significant beneficial impacts minus the number of significant adverse impacts). Tables 4.6-53 and 4.6-54 do not include conductivity, cyanide, or toxicity because only one opportunity for exceedence is possible, except for ammonia in the Russian River. No significant cumulative project impacts of ammonia occurred in the Russian River. No significant adverse impacts are estimated to occur as a result of cumulative projects that are not also estimated to occur as a result of the Santa Rosa reclaimed water design discharge (Project) alone. However, the combination of cumulative projects (which in the Laguna involves substantial nutrient load reduction) and mitigation of the operations avoids all significant water quality impacts of Alternative 5B in the normal hydrologic year. Because wet and dry years were not evaluated for the cumulative scenario, it is not possible to say that Alternative 5B will always be without significant impacts. However, this analysis illustrates the fact that there are few significant impacts of Alternative 5B, and they are reduced by

implementation of the Regional Board's nutrient load reduction strategy in the Laguna.

Impacts are further described below.

Table 4.9-53

Frequency of Significant Adverse Impacts of Cumulative Projects, the Project, and Mitigation Operations

		Percent of the Total Number of Analyses With Signficant Impact							
		Benthic Algae		Planktonic Algae		Turbidity		Dissolved Oxygen	
Discharge Component	No. of Analyses[1]	Project	Mitig	Project	Mitig	Project	Mitig	Project	Mitig
Alt. 1	36	55%	-	0%	-	0%	-	0%	-
Alts. 2&3	36	3%	6%	0%	0%	0%	0%	0%	0%
Alt. 4	36	3%	3%	0%	0%	0%	0%	0%	0%
Alt. 5A	48	27%	15%	0%	0%	0%	0%	0%	0%
Alt. 5B	36	58%	0%	3%	0%	0%	0%	3%	0%

[1] This column shows the maximum number of significant impacts that could be identified using the evaluation approach described in this report (36 = 3 stream segments *x* 12 months/year, 48 = 4 stream segments x 12 months/year).

Table 4.6-54

Frequency of Significant Beneficial Impacts of Cumulative Projects and Mitigation Operations

Discharge Component	No. of Analyses[1]	Percent of the Total Number of Analyses With Signficant Impact					
		Benthic Algae		Planktonic Algae		Turbidity	
		Project	Mitigation	Project	Mitigation	Project	Mitigation
Alt. 1	36	0%	-	6%	-	6%	-
Alts. 2&3	36	8%	6%	0%	0%	0%	0%
Alt. 4	36	3%	8%	0%	0%	0%	0%
Alt. 5A	48	3%	3%	0%	0%	0%	0%
Alt. 5B	36	0%	14%	8%	0%	6%	0%

[1] This column shows the maximum number of significant impacts that could be identified using the evaluation approach described in this report (36 = 3 stream segments *x* 12 months/year, 48 = 4 stream segments x 12 months/year).

Table 4.6-55

Net Impact[1] of Cumulative Projects and Mitigation Operations

Discharge Component	No. Analyses[2]	Number of Analyses[1]					
		Benthic Algae		Planktonic Algae		Turbidity	
		Project	Mitigation	Project	Mitigation	Project	Mitigation
Alt. 1	36	-20	-	+2	-	0	-
Alts. 2&3	36	+2	0	0	0	0	0
Alt. 4	36	0	+2	0	0	0	0
Alt. 5A	48	-12	-6	0	0	0	0
Alt. 5B	36	-21	+5	+2	0	+2	0

[1] Values in this table represent the number of significant beneficial impacts minus the number of significant adverse impacts. Thus, a value greater than zero indicates more significant beneficial impacts than adverse impacts.

[2] This column shows the maximum number of significant impacts that could be identified for benthic algae, planktonic algae, and turbidity using the evaluation approach described in this report (36 = 3 stream segments *x* 12 months/year, 48 = 4 stream segments x 12 months/year).

Table 4.6-56

Significant Adverse and Beneficial Impacts of Project and Cumulative Projects for each Alternative[1]

Constituent	Santa Rosa Creek	Laguna	Russian River Below Laguna	Russian River Above Laguna
Conductivity				*5A*
Dissolved Oxygen		~~5B~~		
Benthic Algae				
Adverse	*1*, **2&3**, 5A, ~~5B~~	*1*, 2&3, 4, 5A, ~~5B~~	*1*, ~~5A~~, ~~5B~~	5A
Beneficial	2&3, **4**, ~~5A~~, 5B	**5B**	2&3, 4, **5A, 5B**	
Planktonic Algae				
Adverse			~~5B~~	
Beneficial	*1*, ~~5B~~	*1*, ~~5B~~		
Turbidity				
Adverse				
Beneficial	*1*, ~~5B~~	*1*, ~~5B~~		

1 Components causing a significant adverse or beneficial impact are shown. Cumulative project impacts were evaluated for a normal hydrologic year. Since impacts were evaluated for all months, both beneficial and adverse impacts can result for some parameters at different times from the same component. Overstriking indicates impact avoided with mitigation or measures that need to be considered by the city for the No Project component, italics indicates no mitigation proposed, bold indicates impacts that are significant after mitigation that are not significant before mitigation. Components are identified as follows:
1 - Alt 1, No Action
2&3 = Alts 2&3, 1% design discharge component
4 = Alt 4, Geysers discharge component
5A = Alt 5A, 20% design discharge component to River
5B = Alt 5B, 20% design discharge component to Laguna

Cumulative project impacts were evaluated for a normal hydrologic year.

Impact: **6.1.C and 6.2C. Will the Project plus cumulative projects cause numeric- narrative-based criteria to be exceeded?**

Analysis: ***Conductivity***

Russian River above The Laguna

Alternative 5A is estimated to cause a significant impact on conductivity. With the assumption that cumulative projects will not lower and may increase baseline conductivity, the impact of cumulative projects on

conductivity in the River above the Laguna will also be considered significant.

Russian River below The Laguna

Attainment of the evaluation criterion for conductivity requires that the median of 12 monthly average conductivity values must be less than or equal to the point of significance, which is 285 µmhos/cm for the Russian River below the Laguna). The monthly average conductivity values estimated to occur with cumulative projects (Table 4.6-57) were compared to the point of significance. The median of the 12 estimated monthly average conductivity values did not exceed the point of significance for the lower River for either Alternative 5A or 5B. Therefore, cumulative projects are expected to have a less than significant impact on conductivity in the lower Russian River.

Table 4.6-57

Estimated Conductivity in the Lower Russian River with Cumulative Projects and 20% Design Discharge to the Laguna and the River

	Lower Russian River (point of significance = 285 µmhos/cm)	
	Alternative 5B	**Alternative 5A**
October	290	272
November	288	269
December	278	277
January	301	298
February	283	282
March	241	240
April	283	280
May	269	268
June	292	292
July	262	262
August	255	255
September	261	261
Median	280	270

Source: Table 4-46 in Water Quality Impacts technical report (Merritt Smith Consulting 1996)

Dissolved Oxygen

The impact of cumulative projects on dissolved oxygen during a normal hydrological year is estimated to be similar to that of the Subregional System Project (Merritt Smith Consulting 1996r). Cumulative projects are estimated to cause exceedence of the point of significance (> 0.5 mg/L decrease) just once (3% of the total possible impacts), and this will occur in the Laguna as a result of Alternative 5B. This significant adverse impact of cumulative projects is reduced by mitigation for biostimulatory substances to below significance (Table 4.6-52).

Biostimulatory Substances

Benthic Algae

The impact of cumulative projects on benthic algae biomass, during a normal hydrological year, is estimated to be similar to that of the Project, as shown in Figure 4-49 of the *Water Quality Impacts Analysis* technical report (Merritt Smith Consulting 1996r). The number of significant adverse impacts estimated to result from cumulative projects is the same as that from the Project for each discharge component except for Alternative 4, in which case cumulative projects caused two fewer significant impacts than that estimated for the Project alone (8% of the total possible impacts with the Subregional System roject alone versus 3% for cumulative projects). Table 4.6-53 shows that the predicted frequency of significant adverse impacts on benthic algae of cumulative projects range from 3 to 58% of the total number of possible significant adverse impacts. As is the case for the Project impacts, mitigation reduces the frequency of impacts of the Project plus cumulative project impacts for some discharge scenarios, but not Alternatives 2 and 3. In contrast to the mitigated Project impact (which caused significant impacts after mitigation, depending on discharge scenarios), cumulative projects with mitigation of Project impacts will cause no significant benthic algae impacts for Alternative 5B. Impacts persist in the Laguna even with mitigation for Alternatives 2, 3, 4, and 5A due to reduced flow relative to existing condition. Reduced flow favors benthic algal growth.

The number of significant beneficial impacts estimated to result from cumulative projects is the same as from the Project for each discharge component (Merritt Smith Consulting 1996r). The predicted frequency of significant beneficial impacts of cumulative projects on benthic algae range from zero to 8% of the total number of possible significant beneficial impacts (Table 4.6-54). The frequency of significant beneficial impacts on benthic algae increases with mitigation for Alternatives 4, and 5B.

Planktonic Algae

The impact of cumulative projects on planktonic algae biomass, during a normal hydrological year, is estimated to be similar to that of the Project (Merritt Smith Consulting 1996r). The single significant adverse impact estimated to result from cumulative projects (on the Russian River below the Laguna with Alternative 5B) is the same as that from the Project. Mitigation for biostimulatory substances is predicted to reduce the single adverse impact on benthic algae resulting from cumulative projects to less than significant levels (Table 4.6-53).

The number of significant beneficial impacts estimated to result from cumulative projects is the same as that from the Project for each discharge component, except for Alternative 5A in the lower Russian River and Alternative 5B in the Laguna. In the lower Russian River with a 20% River discharge, the number of significant beneficial effects of the Project is reduced by cumulative projects from seven to zero. In the Laguna with Alternative 5B, the number of significant beneficial effects of the Project is reduced by cumulative projects from 4 to 3 (from 11% to 8% of the total possible impacts in the normal year). The beneficial impacts on planktonic algae resulting from cumulative projects are predicted to be reduced by mitigation to below significance (Table 4.6-52). The nutrient load from increased wastewater discharges to the Russian River that is associated with cumulative projects is possibly the cause of the reduced number of beneficial Subregional System Project impacts.

Turbidity

The impact of cumulative projects on turbidity, during a normal hydrological year, is estimated to be similar to that of the Project (Merritt Smith Consulting 1996r). The cumulative projects are not predicted to cause significant adverse impacts on turbidity (Table 4.6-53). Significant beneficial impacts of cumulative projects are predicted to occur with Alternative 5B (Table 4.6-54). These beneficial impacts are reduced by mitigation to below significance.

Ammonia-Nitrogen Concentration

The impact of cumulative projects on the concentration of ammonia nitrogen, during a normal hydrological year, is estimated to be similar to that of the Project (Merritt Smith Consulting 1996r). No significant impacts are expected from cumulative projects or for the cumulative projects with predicted mitigation for biostimulatory substances.

SUMMARY OF SIGNIFICANT IMPACTS AND MITIGATION MEASURES

Table 4.6-58

Summary of Impacts and Mitigation Measures - Surface Water Quality

Impact	Level of Significance	Mitigation Measure
No Action Alternative		
6.1.1. The No Action Alternative may cause numeric-based criteria to be exceeded. (See 6.9.1 for detailed description).	Alt 1 - ●	No mitigation
6.1.2. The No Action Alternative may cause narrative-based criteria to be exceeded. (see 6.9.2 for detailed description).	Alt 1 - ●	No mitigation
Storage Reservoir Component		
6.5.1 Ammonia. The storage reservoir component may cause numeric-based criteria to be exceeded.	Alt 2A - ⊙ Alt 2C - ⊙ Alt 2D - ⊙ Alt 3 - ⊙	2.5.3 Control Program for Hydrogen Sulfide, Ammonia, and Dissolved Oxygen.
6.5.1 Dissolved oxygen. The storage reservoir component may cause numeric-based criteria to be exceeded.	Alt 2A - ⊙ Alt 2C - ⊙ Alt 2D - ⊙ Alt 3 - ⊙	2.5.3 Control Program for Hydrogen Sulfide, Ammonia, and Dissolved Oxygen.
6.5.1 Hydrogen sulfide. The storage reservoir component may cause numeric-based criteria to be exceeded.	Alt 2A - ⊙ Alt 2C - ⊙ Alt 2D - ⊙ Alt 3 - ⊙	2.5.3 Control Program for Hydrogen Sulfide, Ammonia, and Dissolved Oxygen.
6.5.3. The storage reservoir component may impact special sites.	Alt 3 - ●	No feasible mitigation has been identified.
Agricultural Irrigation Component		
6.7.1 Dissolved copper. The agricultural irrigation component may cause numeric-based criteria to be exceeded.	Alt 3 - ⊙	2.5.2 Control Program for Dissolved Copper Levels in West County Creeks.

Table 4.6-58

Summary of Impacts and Mitigation Measures - Surface Water Quality

Impact	Level of Significance	Mitigation Measure
6.7.3. Salinity, ammonia, dissolved oxygen, planktonic algae, benthic algae, and metals. The agricultural irrigation component may cause the special site criterion to be exceeded.	Alt 3 - ●	No feasible mitigation has been identified.
Discharge Component		
6.9.1. Conductivity. The discharge component may cause numeric-based criteria to be exceeded.	Alt 5A - ●	No feasible mitigation has been identified.
6.9.1. Cyanide. The discharge component may cause numeric-based criteria to be exceeded.	Alt 1 - ● Alt 5B - ⊙	2.5.5. Cyanide Monitoring and Source Control Program.
6.9.1. Dissolved oxygen. The discharge component may cause numeric-based criteria to be exceeded.	Alt 5B - ●	No feasible mitigation has been identified.
6.9.2. Biostimulatory Substances. The discharge component may cause narrative based criteria to be exceeded.	Alt 1 - ● Alt 2 - ● Alt 3 - ● Alt 4 - ● Alt 5 - ●	2.5.4 Discharge Operations.
6.9.2. Biostimulatory Substances. Beneficial. The discharge component may cause narrative-based criteria to be exceeded.	Alt 1 - + Alt 2 - + Alt 3 - + Alt 4 - + Alt 5 - +	None required.
6.9.2. Turbidity-Adverse. The discharge component may cause narrative-based criteria to be exceeded.	Alt 5 - ●	2.5.4 Discharge Operations.
6.9.2. Turbidity. Beneficial. The discharge component may cause narrative-based criteria to be exceeded.	Alt 1 - + Alt 5A - + Alt 5B - +/○	None required.

Table 4.6-58

Summary of Impacts and Mitigation Measures - Surface Water Quality

Impact	Level of Significance	Mitigation Measure
6.9.2. Waste Reduction Strategy - Total Nitrogen-Adverse. The discharge component may cause narrative-based criteria to be exceeded..	Alt 1 - ● Alt 5B - ⊙	2.5.6 Total and Ammonia Nitrogen Source Control Program.
6.9.2. Waste Reduction Strategy-Total Nitrogen-Beneficial. The discharge component may cause narrative-based criteria to be exceeded.	Alt 2 - + Alt 3 - + Alt 4 - + Alt 5A - + Alt 5B - ○/+	None required.
6.9.2. Waste Reduction Strategy-Ammonia-Nitrogen-Adverse. The discharge component scenarios may cause narrative-based criteria to be exceeded.	Alt 1 - ● Alt 5B - ⊙	2.5.6 Total and Ammonia Nitrogen Source Control Program.
6.9.2. Waste Reduction Strategy-Ammonia-Nitrogen-Beneficial. The discharge component may cause narrative-based criteria to be exceeded.	Alt 2 - + Alt 3 - + Alt 4 - + Alt 5A - + Alt 5B - ○/+	None required.
6.9.2. Toxicity (lethal effects). The discharge component may cause narrative-based criteria to be exceeded.	Alt 1 - ● Alt 5B - ⊙	2.5.7 Toxicity Control Program.

Source: Merritt Smith Consulting 1996

Notes: Level of significance codes:

○	Less than significant impact; no mitigation proposed
⊙	Significant impact before mitigation; less than significant impact after mitigation
●	Significant impact before and after mitigation, except for the No Action component for which the symbol represents significant impact and no mitigation is proposed
○/+	Significant beneficial impact occurs only as a result of mitigation to address adverse impact.
+/○	Significant beneficial impact does not occur after mitigation is implemented to address adverse impact.

SUMMARY OF IMPACTS BY ALTERNATIVE

Table 4.6-59 summarizes the impacts by alternative.

Table 4.6-59

Summary of Impacts by Alternative - Surface Water Quality

Component	Alt 1	Alt 2A	Alt 2B	Alt 2C	Alt 2D	Alt 3A	Alt 3B	Alt 3C	Alt 3D	Alt 3E	Alt 4	Alt 5A	Alt 5B
No Action (No Project) Alternative	+●	--	--	--	--	--	--	--	--	--	--	--	--
Headworks Expansion	--	==	==	==	==	==	==	==	==	==	==	==	==
Urban Irrigation	--	==	==	==	==	==	==	==	==	==	--	--	--
Pipelines	--	○	○	○	○	○	○	○	○	○	○	○	--
Storage Reservoirs	--	⊙	○	⊙	⊙	●	●	●	●	●	--	--	--
Pump Stations	--	==	==	==	==	==	==	==	==	==	==	==	--
Agricultural Irrigation	--	○	○	○	○	●	●	●	●	●	--	--	--
Geysers Steamfield	--	--	--	--	--	--	--	--	--	--	==	--	--
Discharge	--	+●	+●	+●	+●	+●	+●	+●	+●	+●	+●	+●	●
Cumulative Impacts	==	==	==	==	==	==	==	==	==	==	==	==	1

Source: Merritt Smith Consulting 1996

Notes: Level of Significance Codes:

- -- Not applicable
- == No impact
- ○ Less than significant impact; no mitigation proposed
- ⊙ Significant impact; less than significant after mitigation
- ● Significant impact before and after mitigation, except for the No Action component for which the symbol represents significant impact and no mitigation is proposed
- \+ Beneficial impact

1. Water quality impacts from the Project plus cumulative projects will decrease resulting in all impacts being mitigable to a level below significance.

Table 4.6-60 summarizes the significant adverse and beneficial impacts of Project components on surface water quality, and the level of significance after implementation of mitigation. Storage, irrigation, and discharge components were found to have a significant impact, and other components were found to cause a less-than-significant impact or no impact. The impacts of the storage, irrigation, and discharge components are discussed below.

Storage Reservoir Component

Construction of a storage reservoir is included in Alternatives 2 and 3. Storage reservoirs will have a significant effect on water quality immediately downstream of a dam due to seepage from the reservoir. This will be mitigated by intercepting any seepage that discharges to surface water and pumping it back to the reservoir.

Storage will also affect flow, and, in West County, changes in flow are considered to result in a significant impact on water quality in the Estero de San Antonio or the Estero Americano (part of the Gulf of the Farallones National Marine Sanctuary). Any water quality impact in the Sanctuary is considered to be significant. Measures have been adopted as part of the Project which will reduce this significant impact, but no mitigation has been identified which will avoid impacts in the esteros altogether.

Agricultural Irrigation Component

Subflow from irrigation that discharges to streams in West County (Alternative 3) will cause a significant impact in Stemple and Americano creeks with respect to the concentration of dissolved copper. Mitigation involves reducing irrigation acreage to avoid a significant impact.

Irrigation, like storage, is projected to affect the flow in West County streams. Although storage alone will slightly decrease stream flow, the combined effect of storage and irrigation is to increase flow into the esteros by up to about 2.5 cfs. Measures have been adopted as part of the Project to improve management of animal waste and other agricultural materials in the watershed. The combined effect of reduced animal waste and slightly increased flow will have a small, but significant impact on water quality in the esteros. No mitigation has been identified which will completely avoid impacts in the esteros.

Discharge Component

The No Action Alternative (Alternative 1) will involve continued discharge to the Laguna, but if the City takes no action on a Long-Term Project, CEQA does not require mitigation for impacts. Therefore, Alternative 1 is considered to have a greater impact than the 20% design discharge (Alternative 5). The impact of cumulative projects plus the discharge under the No Action Alternative component is similar to the impact of the No Action discharge alone.

Discharge to the Laguna at the 1% design discharge rate (Alternatives 2 and 3) was found to have significant beneficial and adverse impacts on biostimulatory substances (algal growth). The quarter-mile reach of Santa Rosa Creek downstream of the Delta Pond discharge is an ideal habitat for growth of attached algae under particular conditions, and a 1% design discharge will occasionally (once every 18 months) cause an increase in attached algae relative to existing conditions. The 1% design discharge will more often (in five of 18 months) cause a beneficial decrease in attached algae. The 1% design discharge will cause planktonic algae to increase in the Laguna because flows will be reduced (which favors buildup of planktonic algae) relative to existing conditions. Mitigation has not been identified which will reduce the frequency of adverse impacts on attached or planktonic algae due to the 1% design discharge. Implementation of the 1% design discharge will also meet the Regional Board's waste load reduction goals because the quantity of nitrogen being discharged to the Laguna will be reduced relative to existing conditions. The combination of reduced nutrient loads in the Laguna (as a result of the cumulative projects) with the 1% design discharge further reduces the frequency of adverse impacts and increases the frequency of beneficial impacts.

Discharge to the Laguna at the 20% design discharge rate (Alternative 5B) was found to have many more adverse impacts than the 1% design discharge, but mitigation (including emphasizing discharge in winter relative to fall and spring) will reduce the number of impacts on algae in Santa Rosa Creek and the Laguna to a level that is only slightly greater than that of the 1% design discharge. The mitigated 20% design discharge to the Laguna will occasionally (once every 12 months) cause significant impacts in the Russian River that will not occur with the 1% design discharge. The mitigated 20% design discharge to the Laguna results in more beneficial than adverse impacts. With mitigation, the 20% design discharge will very rarely cause a significant impact with respect to dissolved oxygen. This impact will only occur because the 20% design discharge alternative beneficially reduces algae under certain conditions, and reduced algae paradoxically leads to less production of dissolved oxygen. The 20% design discharge will cause significant impacts on turbidity, cyanide, toxicity and waste load reduction, all of which could be mitigated to a less-than-significant or even beneficial level. The impact of cumulative projects plus the mitigated 20% Laguna discharge component is less than significant.

The 20% design discharge to the Russian River (Alternative 5A) will cause growth of attached algae in the River similar to that caused by the 20% design discharge to the Laguna via Santa Rosa Creek. With mitigation, the 20% design discharge to the River results in more beneficial than adverse impacts. Discharge to the Laguna will occur occasionally under Alternative 5A, and the frequency and amount of this Laguna discharge is similar to that under Alternative 4 (Geysers). Even under Alternatives 4, and 5A, occasional significant impacts on attached algae in lower Santa Rosa Creek will occur. Such impacts will also occur with implementation of cumulative projects.

Table 4.6-60

Summary of Significant Adverse and Beneficial Surface Water Quality Impacts[1]

Evaluation Criterion	Santa Rosa Creek	Laguna	Russian River	West Co. Creeks	Esteros	Tolay Creek	Petaluma River	Other Waters
Dissolved Copper	None	None	None	~~Irrig~~	*Irrigation & Storage (any water quality change is significant, and changes in many parameters are predicted)*	None	None	None
Ammonia	See Waste Red. Strategy	See Waste Red. Strategy	None	~~Storage~~		~~Storage~~	None	None
Conductivity	Criterion not applicable		*20% River*	Criterion NA		Criterion not applicable		
Cyanide	~~20%,~~ *NP*	~~20%~~, *NP*	None	None		None	None	None
Dissolved Oxygen	**20%**	20%	None	~~Storage~~		~~Storage~~	None	None
Hydrogen Sulfide	None	None	None	~~Storage~~	None	~~Storage~~	None	None

Table 4.6-60

Summary of Significant Adverse and Beneficial Surface Water Quality Impacts[1]

Evaluation Criterion	Santa Rosa Creek	Laguna	Russian River	West Co. Creeks	Esteros	Tolay Creek	Petaluma River	Other Waters
Biostimulatory Substances - Benthic algae					*Irrigation & Storage (any water quality change is significant, and changes in many parameters are predicted)*			
• Adverse	1%,20%, 20% River, *NP*, G	1%, 20%, 20% River, *NP*, G	20%, 20% River, *NP*	None		None	None	None
• Beneficial	1%, **20%**, 20%River, G, *NP*	1%, **20%**, 20%River, G, *NP*	1%, **20%**, 20%River, G, *NP*	None		None	None	None
Biostimulatory Substances Planktonic algae								
• Adverse		1%, 20%River	20%, 20% River	None		None	None	None
• Beneficial	20%, *NP*	20%, *NP*	20% River	None		None	None	None
Turbidity								
• Adverse			~~20% River~~					
• Beneficial	*NP*, ~~20%~~	*NP*, ~~20%~~	20% River					
Waste Reduction Strategy			Criterion not applicable					
• Total Nitrogen								
♦ Adverse	~~20%~~, *NP*							

Table 4.6-60

Summary of Significant Adverse and Beneficial Surface Water Quality Impacts[1]

Evaluation Criterion	Santa Rosa Creek	Laguna	Russian River	West Co. Creeks	Esteros	Tolay Creek	Petaluma River	Other Waters
♦ Beneficial	1%, 20% River, G							
• Ammonia N								
♦ Adverse	~~20%~~, *NP*							
♦ Beneficial	1%, 20% River, G							
Lethal Toxicity (Lethal)	~~20%,~~ *NP*	Evaluated in Santa Rosa Creek, where worst-case conditions occur		None	None	None	None	None
Other criteria	None	None	None	None	See top note	None	None	None

1. Components causing a significant adverse or beneficial impact are shown. Since impacts were evaluated for all months and three hydrologic years, both beneficial and adverse impacts can result for some parameters at different times from the same component. Overstriking indicates impact avoided with mitigation or measures that need to be considered by the city for the No Project component, italics indicates no mitigation proposed, bold indicates impacts significant after mitigation that are not significant before mitigation. Components are identified as follows:
1% = 1% design discharge component (Alts 2&3)
NP = No Project discharge component (Alt 1)
Irrigation=irrigation in related Project area
20% River = 20% design discharge component to River (Alt 5A)
G = Geysers discharge component (Alt 4)
20% = 20% design discharge component to Laguna (Alt 5B)
Storage = Storage reservoir

PREPARERS, REFERENCES, AND CONSULTATION AND COORDINATION

Preparers

Dave Smith, Ph.D., Merritt Smith Consulting
Marcie Commins, Ph.D., Commins Consulting
Rick Maddox, Merritt Smith Consulting

Reviewers

Robin P. Cort, Ph.D., Parsons Engineering Science, Inc.
Patricia I. Collins, Harland Bartholomew & Associates, Inc.
Anders J. Hauge, Harland Bartholomew & Associates, Inc.
John Cummings, Ph.D., Peer Review Committee
David Ziegler, Peer Review Committee

References

HBA Team Documents

Merritt Smith Consulting. 1996a. *Anadromous Fish Migration Study Program, 1991-1994.* (Appendix L-1).

Merritt Smith Consulting. 1996b. *Anadromous Fish Migration Study Program, 1991-1995.* (Appendix L-2).

Merritt Smith Consulting. 1996c. *Aquatic Biological Resources Impacts Analysis Report.* (Appendix L-7).

Merritt Smith Consulting. 1996d. *Aquatic Habitat Survey Results.* (Appendix L-4).

Merritt Smith Consulting. 1996e. *Aquatic Life Survey Results.* (Appendix L-5).

Merritt Smith Consulting. 1996f. *Development of Evaluation Criteria for Potential Water Quality Impacts.* (Appendix I-12).

Merritt Smith Consulting. 1996g. *Environmental Conditions in West County Waterways.* (Appendix 1-3).

Merritt Smith Consulting. 1996h. *Evaluation of Bioaccumulation in Organisms Exposed to Reclaimed Water from the Santa Rosa Subregional System.* (Appendix L-6).

Merritt Smith Consulting. 1996i. *Irrigation/Storage Stream Water Quality Monitoring Results.* (Appendix I-5).

Merritt Smith Consulting. 1996j. *Laguna de Santa Rosa Water Quality Monitoring Results*. (Appendix I-4).

Merritt Smith Consulting. 1996k. *Reclaimed Water Quality*. (Appendix H-2).

Merritt Smith Consulting. 1996l. *Reclaimed Water Quality Update*. (Appendix H-3).

Merritt Smith Consulting. 1996m. *Russian River Algae and Macrophytes Assessment*. (Appendix I-7).

Merritt Smith Consulting. 1996n. *Russian River Water Quality Monitoring Results*. (Appendix I-6).

Merritt Smith Consulting. 1996o. *Sediment Quality Characterization and Impact Assessment*. (Appendix I-13).

Merritt Smith Consulting. 1996p. *Stream Crossings Assessment*. (Appendix I-15).

Merritt Smith Consulting. 1996q. *Treatment Wetlands Evaluation*. (Appendix I-9).

Merritt Smith Consulting. 1996r. *Water Quality Impacts Analysis Report Volume I*. (Appendix I-16).

Parsons Engineering Science, Inc. 1996a. *Ecological Risk Assessment*. (Appendix K-4).

Parsons Engineering Science, Inc. 1996b. *Water Balance Contingency Plan*. (Appendix D-10).

Parsons Engineering Science, Inc. 1996c. *Human Health Risks from Chemical and Biological Components of Reclaimed Water*. (Appendix J-3).

Parsons Engineering Science, Inc. 1996d. *Water Balance Model Summary and Results*. (AppendixD-8).

Questa Engineering Corporation. 1996a. *Evaluation of Metals in Irrigation-affected Percolate*. (Appendix I-2).

Questa Engineering Corporation. 1996b. *Baseline Hydrology and Irrigation Drainage Evaluation for West and South County Reclamation Alternatives*. (Appendix I-10).

Questa Engineering Corporation. 1996c. *Estimation of Nitrogen, Salts and Herbicide/Pesticide Concentrations in Surface Water*. (Appendix I-1).

Questa Engineering Corporation, Inc.. 1996d. *Urban Irrigation Management Guidelines*. (Appendix D-20).

Questa Engineers Corporation. 1996e. *Hydrologic/Water Quality Evaluation of Irrigation of Bay Lands (Reyes Soils) with Reclaimed Water*. (Appendix I-14).

Resource Management Associates. 1996a. *Water Quality and Flow Model for Irrigation/Storage Area Streams*. (Appendix I-11).

Resource Management Associates. 1996b. *Russian River Water Quality Model*. (Appendix I-8).

Other References

California Coastal Commission. 1987. *Sonoma County Coastal Wetland Enhancement Plan.*

California Department of Fish and Game. 1977. *The Natural Resources of Esteros Americano and de San Antonio. Coastal Wetland Series #20.*

CH2M Hill. 1994 . *Laguna de Santa Rosa Water Quality Objective Attainment Plan*. June.

City of Petaluma. 1994. *Draft Environmental Impact Report - Petaluma Wastewater Treatment and Storage Facilities Project*. December.

City of Santa Rosa. 1989. *Technical Memorandum No. E5. Preliminary Estero Americano Discharge Criteria.*

City of Santa Rosa. 1990a. *Technical Memorandum No. E8. Estero Americano and Estero de San Antonio Monitoring Program: 1988-89 Results.*

City of Santa Rosa. 1990b. *Technical Memorandum No. 9. Predicted Nitrogen Concentrations for Stemple/Americano Creek Area.*

City of Santa Rosa. 1990c. *Technical Memorandum No. P8. Development of Wetland and Discharge Components of the South County Reclamation Alternative.*

City of Santa Rosa. 1990d. *Technical Memorandum No. R10. Water Quality Results from Quarterly Groundwater Sampling 1988/89 in the Stemple/Americano Creek Area.*

City of Santa Rosa. 1992. *Technical Memorandum. Final Report: 1990-1991 Laguna de Santa Rosa Water Quality Monitoring Program.*

City of Santa Rosa. 1993. *Technical Memorandum. Final Report: 1991-1992 Laguna de Santa Rosa Water Quality Monitoring Program.*

City of Santa Rosa. 1994a. *Laguna de Santa Rosa Water Quality Objective Attainment Plan.* Prepared by CH2M Hill and Merritt Smith Consulting.

City of Santa Rosa. 1994b. *Technical Memorandum. Final Report: 1992-1993 Laguna de Santa Rosa Water Quality Monitoring Program.*

City of Santa Rosa. 1995. *Laguna de Santa Rosa Water Quality Monitoring Program 1993-1994.*

EPA. 1993a. *Sediment Quality Criteria for the Protection of Benthic Organisms: Acenaphthene.* EPA-822-R-93-013. Washington D.C.

EPA. 1993b. *Sediment Quality Criteria for the Protection of Benthic Organisms: Dieldrin.* EPA-822-R-93-015. Washington D.C.

EPA. 1993c. *Sediment Quality Criteria for the Protection of Benthic Organisms: Endrin.* EPA-822-R-93-016. Washington D.C.

EPA. 1993d. *Sediment Quality Criteria for the Protection of Benthic Organisms: Fluoranthene.* EPA-822-R-93-012. Washington D.C.

EPA. 1993e. *Sediment Quality Criteria for the Protection of Benthic Organisms: Phenanthrene.* EPA-822-R-93-014. Washington D.C.

Gold Ridge Resource Conservation District. 1995. *Animal Waste Control Demonstration Project. Manure Management Publication Project Repor.* June.

Marin County Resource Conservation District. 1994. *Stemple Creek/Estero de San Antonio Watershed Enhancement Plan.*

McMillan, L. E., ed. 1985. *Geysers-Calistoga KGRA-ARM Program 1982-1983 annual report.* 2 vols.

North Coast Regional Board (North Coast Regional Water Quality Control Board). 1994 . *Water Quality Control Plan for the North Coast Basin (Basin Plan).*

North Coast Regional Board (North Coast Regional Water Quality Control Board). 1995. *Waste Reduction Strategy for the Laguna de Santa Rosa.*

San Francisco Estuary Institute. 1994. *1993 Annual Report, San Francisco Estuary Regional Monitoring Program for Trace Substances.*

Bay Regional Board (San Francisco Bay Regional Water Quality Control Board). 1995. *Water Quality Control Plan for the San Francisco Bay Basin (Basin Plan).*

Sonoma County Planning Department. 1994. *Sonoma County Aggregate Resources Management Plan and Environmental Impact Report.* November.

Sonoma County Water Agency. 1993. *Russian River Demonstration Study.*

Consultation and Coordination

Persons Contacted

Tuck Vath, North Coast Regional Water Quality Control Board
Bill Cox, Department of Fish and Game
Jim Flugum, Sonoma County Water Agency
Randy Piazza, City of Santa Rosa
Dean Paige, City of Santa Rosa
Scott Stinebaugh, City of Santa Rosa

Correspondence

None

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

4.7 PUBLIC HEALTH AND SAFETY

This section discusses the Project's potential to expose the public to chemicals, radionuclides, pathogenic viruses, bacteria or other disease organisms, potential to expose worker or the public to hazards from a know hazardous waste site, potential release of hazardous materials, safety hazards, flooding hazards, and disease vectors. To allow evaluation of these impacts, existing drinking water supplies are characterized, and regulations for water reclamation and wastewater discharge are presented. Reclaimed water quality is evaluated and potential pathways for public exposure to contaminants are described. Information on known hazardous waste sites in the Project area and hazardous materials storage and use at the Laguna Plant is summarized. Policies and regulations regarding construction hazards, flooding hazards and vector control are presented.

IMPACTS EVALUATED IN OTHER SECTIONS

The following items are related to Public Health and Safety but are evaluated in other sections of this document.

- Geologic and Flooding Hazards. These are discussed in Section 4.3, Geology, Soils, and Seismicity, and Section 4.4, Surface Water Hydrology, respectively.
- Water Quality Issues Regarding Groundwater and Surface Water. These issues are evaluated in Section 4.5, Groundwater, and Section 4.6, Surface Water Quality.
- Emergency Response Plans. Section 4.11, Transportation, discusses and evaluates impacts of the project required lane closures upon emergency services.
- Inundation from Dam Failure. Section 4.19, discusses the potential inundation areas from a dam failure.

AFFECTED ENVIRONMENT (SETTING)

Water Use, Reuse, and Discharge

The Project alternatives propose to release reclaimed water to the environment via four primary mechanisms, reuse for agricultural irrigation, reuse for urban irrigation, discharge to the Russian River or Laguna de Santa Rosa, and injection into the geysers steamfield. These release mechanisms provide several potential pathways (inhalation, dermal contact, and ingestion) via which humans may be exposed to reclaimed water. The affected environment for drinking water supplies, water reuse and reclamation, and wastewater discharge and the regulations which govern them are discussed below, followed by a summary of the findings of a human health risk assessment that evaluates potential exposure to reclaimed water via the Project alternatives (Parsons Engineering Science, Inc. 1995).

Drinking Water Supplies

The quality of drinking water within the Project area, and for most Californians, is regulated under the California Safe Drinking Water Act (California Health & Safety Code, Section 4010 *et seq.*) and the California Domestic Water Quality and Monitoring Regulations (Title 22, California Code of Regulations, Sections 64401 *et seq.*). These State laws and regulations are at least as stringent as Federal drinking water laws and regulations and California has been authorized by the U.S. Environmental Protection Agency (EPA) to operate its own drinking water program. The California Department of Health Services, Office of Drinking Water is responsible for enforcing the State's drinking water program.

The California Safe Drinking Water Act defines two general types of water delivery systems: Public Water Systems (there are subdivisions within this category) and State Small Water Systems (Table 4.7-1). Public Water Systems must meet the requirements of the Safe Drinking Water Act whereas the State Small Water Systems are excluded from the provisions of the Act (California Health and Safety Code §4010.8) as are private wells and systems with less than five service connections. Separate regulations have been adopted by California to cover Public Water Systems (Title 22, California Code of Regulations §64401 *et seq.*) and State Small Water Systems (Title 22, California Code of Regulations §64201 *et seq.*). Public Water Systems in Sonoma County are regulated by the California Department of Health Services, Office of Drinking Water. State Small Water Systems in Sonoma County are regulated by the Sonoma County Environmental Health Department.

Table 4.7-1

Regulation of Water Delivery Systems

Type of System	Definition	Oversight Agency
Public Water System	System that provides piped water to the public for human consumption which serves at least 15 connections or 25 individuals daily at least 60 days per year. Public Water Systems are classified as Community, Transient, Non-community, and Non-transient Water Systems.	Department of Health Services
State Small Water System	System that provides piped water to the public for human consumption which serves at least five, but not more than 14, service connections and does not regularly serve more than 25 individuals daily for more than 60 days per year.	Sonoma County Environmental Health Department

Source: California Code of Regulations

Both federal and state regulations contain primary and secondary drinking water standards (called maximum contaminant levels or MCLs) for the maximum permissible concentrations of organic and inorganic chemicals and for radionuclides in domestic water supplies delivered by a Public Water System. State MCLs are required to be at least as stringent as federal MCLs (California Health and Safety Code §4023.1). The MCLs were set to be protective of human health, taking water treatment technology and cost into account. Public Water Systems must have a regular program for monitoring the concentrations of these chemicals and radionuclides. If an MCL is exceeded by a Public Water System, the system must report these results to the State, notify the public, and take action to bring the level of that contaminant to or below its MCL.

The largest Public Water Systems in the Project area are the Sonoma County Water Agency and the municipal systems operated by Santa Rosa, Petaluma, Cotati, Sebastopol, and Rohnert Park. Sonoma State University operates a water system east of Rohnert Park. There are also numerous smaller systems operated by private companies that supply individual businesses or developments (e.g., restaurants, vineyards, apartment complexes, trailer parks). The systems in the study area rely primarily upon the Russian River or groundwater as the source of water. Santa Rosa and Petaluma receive most of their water from the Sonoma County Water Agency, which relies on intakes on the Russian River, while the remaining communities receive all or most of their water from groundwater (Rohnert Park and Cotati receive some water, about 20 percent or less of their total, from the Sonoma County Water Agency). The Sonoma County Water Agency estimates that it supplies drinking water to approximately 500,000 people in Sonoma and Marin Counties. The cities of Santa Rosa and Petaluma reportedly have approximately 43,000 and 15,000 metered users, respectively. The cities of Cotati, Sebastopol, and Rohnert Park have about 3,000 (or less) users each.

The drinking water supplied to residents of Santa Rosa, Petaluma, Cotati, Sebastopol, and Rohnert Park is tested each year to ensure that high quality drinking water is maintained. Drinking water for these public water systems was at or below MCLs in 1994 (City of Santa Rosa Utilities Department 1994; City of Petaluma 1994; City of Cotati 1994; City of Sebastopol Department of Public Works 1994; City of Rohnert Park 1994; Sonoma County Water Agency 1994). Only a few chemical, biological, and radiological constituents have been detected in the drinking water of these communities (Table 4.7-2). Detected constituents were primarily inorganic chemicals (e.g., arsenic, fluoride, lead, and nitrate) and trihalomethanes. Chlordane was detected in one sample collected in Sebastopol. Radionuclides, reported as gross alpha and gross beta radiation, were present at low levels in some systems. Coliform bacteria were reported in a few samples collected from the Sonoma County Water Agency drinking water sources along the Russian River and at several distribution points monitored by the City of Santa Rosa. However, fewer than 5% of the samples were found to contain coliform bacteria, a level which meets the MCL.

Table 4.7-2

Detected Contaminants in Municipal Drinking Water Supplies (1994)

				Sonoma County Water Agency Intakes		Santa Rosa Water Sample Station				Sebastopol			
Constituent	Units	State MCL	Federal MCL	Wohler	Mirabel	046	001	Petaluma	Rohnert Park	Well 2	Well 4	Well 6	Cotati
INORGANICS													
Aluminum	mg/L	1	N/A	ND	0.3	ND	ND	0.3	ND	ND	ND	ND	ND
Arsenic	mg/L	0.05	0.05	ND	ND	ND	0.0064	ND	0.0026	0.01	0.01	0.026	ND
Barium	mg/L	1	2	0.36	0.11	0.11	ND	0.1	0.04	ND	ND	ND	0.11
Fluoride	mg/L	N/A	4	0.1	0.1	0.19	ND	ND	0.1	ND	ND	ND	0.16
Lead	mg/L	0.015(1)	0.015(1)	ND	ND	ND	ND	ND	0.009	ND	ND	ND	ND
Nitrate as nitrogen	mg/L	10	10	ND	ND	0.65	ND	ND	1.5	0.7	2.0	0.6	0.10-0.43
ORGANICS													
Volatiles													
Trihalomethanes	mg/L	0.1	0.1	NR	NR	0.01	0.01	0.013	0.0085	ND	ND	0.0024	0.00052
Non-Volatiles													
Chlordane	mg/L	0.0001	0.002	ND	ND	ND	ND	ND	ND	ND	ND	0.0001	NR
MICROBIOLOGY													
Total Coliform Bacteria	% positive samples	<5%	<5%	0%	Present in 3 samples	0.22%	0.22%	ND	0%	0%	0%	0%	0%

Table 4.7-2

Detected Contaminants in Municipal Drinking Water Supplies (1994)

				Sonoma County Water Agency Intakes		Santa Rosa Water Sample Station				Sebastopol			
Constituent	**Units**	**State MCL**	**Federal MCL**	**Wohler**	**Mirabel**	**046**	**001**	**Petaluma**	**Rohnert Park**	**Well 2**	**Well 4**	**Well 6**	**Cotati**
SECONDARY STANDARDS													
Chloride	mg/L	N/A	250	7.3	5.3	5	4.5	5.3	19.9	12	18	13	46
Iron	mg/L	N/A	0.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Manganese	mg/L	N/A	0.05	ND	ND	ND	ND	ND	0.005	ND	ND	ND	0.035
Sulfate	mg/L	N/A	250	13	13	12	12	13	11.6	20	9.8	19	11
Total Dissolved Solids	mg/L	N/A	500	130	140	180	160	140	277	250	250	230	260
Zinc	mg/L	N/A	5	0.21	ND	ND	0.059	ND	0.012	ND	ND	ND	ND
RADIOACTIVITY													
Gross Alpha	pCi/L	N/A	15	0.8	0.7	1.3	ND	0.7	0.2	ND	ND	ND	NR
Gross Beta	pCi/L	N/A	50	NR	NR	2.9	1.7	NR	NR	NR	NR	NR	NR

Source: City of Cotati, 1994; City of Petaluma, 1994, City of Rohnert Park, 1994, City of Santa Rosa Utilities Department, 1994, City of Sebastopol Public Works Department 1994, Sonoma County Water Agency, 1994

Notes:
N/A = Not available
NR = Not Reported
ND = Not detected at or above the reporting limit
mg/L = milligrams per liter or parts per million
µmhos/cm = Micromhos per centimeter
pCi/L = picoCuries per liter
NTUs = Nephelometric Turbidity Units
MPN/100mL = Most Probable Number per 100 milliliters
(1) Action level.

The North Coast and San Francisco Bay Regional Water Quality Control Boards have developed Water Quality Control Plans (Basin Plans) to protect surface and groundwater within the Project area. The Basin Plans identify water for domestic use (including drinking water supply) by community, military, or individual water supply systems as a protected beneficial use. The principal issues involving municipal water supply quality are protection of public health, aesthetic acceptability of the water, and the economic impacts associated with treatment or quality-related damages.

Health considerations include direct disease transmission by biological agents (e.g., typhoid fever or cholera), toxic effects (e.g., methemoglobinemia or "blue babies" caused by nitrate or nitrite), and increased susceptibility to disease (e.g., increased risk of cancer from exposure to halogenated organic compounds). Aesthetic considerations include unpleasant odors or taste, turbidity, color, and excessive hardness. Published water quality objectives (e.g., MCLs as discussed above) give limits for known health-related constituents and most properties (e.g., odor, color, taste) affecting public acceptance and are the basis for the numerical water quality criteria identified in the Basin Plans.

The water quality objectives for groundwater consist of both narrative and numerical objectives and apply to all groundwaters, not just at a wellhead or at a point of consumption. The maintenance of existing high quality of groundwater (i.e., background) is the primary narrative groundwater objective. In addition, the Basin Plans specify that groundwater with a beneficial use of municipal and domestic supply shall not contain concentrations of bacteria, chemical constituents, radioactivity, or substances producing taste and odor in excess of human health objectives, as identified by the EPA and the California Department of Health Services, unless naturally occurring background concentrations are greater. Quantitative objectives include (1) the median of the MPN (most probable number) of coliform organisms over any seven-day period shall be less than 1.1 MPN/100 mL and (2) groundwaters shall be maintained free of organic and inorganic chemical constituents in concentrations that adversely affect beneficial uses. At a minimum, they shall not contain concentrations of chemical constituents or radionuclides in excess of the state or federal MCLs or secondary MCLs, whichever is less.

Water Reclamation and Reuse

Untreated wastewater potentially contains pathogenic organisms (i.e., bacteria, viruses, and parasites) that must be removed to allow safe use of reclaimed water. The potential for pathogenic contamination of reclaimed water is expressed as the number (measured by the Most Probable Number [MPN]) of coliform bacteria present in water sources. Coliform bacteria are "indicator organisms" whose presence is evidence that pollution (associated with fecal contamination from humans or other warm-blooded animals) has occurred. Indicator organisms may be accompanied by pathogens, but do not necessarily cause disease themselves. Indicators have the following general characteristics: they are absent from unpolluted waters; are present in greater numbers than pathogenic organisms; have greater survival time than pathogens; and their detection is generally more reliable and less time-consuming.

To ensure an appropriate level of treatment for protection of public health from pathogenic organisms, the California Department of Health Services has established treatment requirements for a variety of reclaimed water uses (Title 22, California Code of Regulations, §60301 *et seq.*). These conventional and widely practiced water and wastewater treatment processes are believed to be capable of reducing pathogenic constituents to acceptable levels. The California Department of Health Services has proposed changes to these existing regulations and submitted these changes for public review and comment. These revisions have not been adopted, but are currently being used as guidance by regulatory agencies, such as the Regional Water Quality Control Boards (Regional Boards) (Hulquist 1996).

Current Title 22 criteria for reclaimed water are intended to prevent transmission of disease by any of the possible mechanisms: skin contact; ingestion; or inhalation of infectious agents in water or by direct contact with a contaminated object. Reclaimed water must be treated to an appropriate level to protect surface water and to prevent transmission of pathogens through aerosols (small particles of water suspended in air) from spray irrigation. The level of treatment, required in the proposed revision to Title 22, varies with the ultimate use of the reclaimed water but at minimum, wastewater must receive secondary treatment prior to use as reclaimed water (Table 4.7-3). The most stringent criteria require secondary treatment plus advanced treatment processes of coagulation, clarification, filtration, and disinfection. The level of disinfection required depends upon the ultimate use of the water, but the most restrictive requirement (for nonrestricted recreational impoundments and spray irrigation) is a median coliform level that does not exceed 2.2 MPN/100 mL and a maximum coliform level that does not exceed 23 MPN/100 mL more than once in a 30-day period. Filtration must reduce turbidity to 2 turbidity units or less. Basin Plan water quality objectives for nonrestricted recreational impoundments are less stringent. Median coliform bacterial levels cannot exceed 240 MPN/100 mL, and no sample can exceed 10,000 MPN/100mL.

Reclaimed water from the existing Subregional System meets requirements for unrestricted use and is used in accordance with Title 22 regulations. Uses approved by Title 22 specifically include irrigation of food crops, parks and playgrounds, school yards, residential landscaping, unrestricted access golf courses, pasture for animals producing milk for human consumption, and a variety of other uses. Use of reclaimed water is not allowed within a food-handling facility, so it is assumed that reclaimed water could not be used within a milking area (e.g. for cleaning udders). However, the use of reclaimed water for livestock watering is not prohibited.

Table 4.7-3

Categories of Reclaimed Water Usage

General Use Category	Definition	Disinfection Criteria
Spray Irrigation Nonrestricted Recreational Impoundment	The application of reclaimed water to crops by spraying it from orifices in piping. A body of reclaimed water in which no limitations are imposed on body-contact water sport activities.	Water shall be adequately disinfected, oxidized, coagulated, clarified, and filtered wastewater. Coliform not to exceed 2.2 MPN per 100 mL (based on the last 7 days for which analyses have been completed) at some point in the treatment process and the total number of coliform not to exceed 23 per 100 mL in more than one sample within a 30-day period.
Surface Irrigation Restricted Recreational Impoundment	The application of reclaimed water by means other than spraying such that contact between the edible portion of any food crop and reclaimed water is prevented. A body of reclaimed water in which recreation is limited to fishing, boating, and other non-body-contact water recreational activities.	Water shall be adequately disinfected and oxidized. Coliform not to exceed 2.2 MPN per 100 mL (based on the last 7 days for which analyses have been completed) at some point in the treatment process.
Landscape Impoundment	A body of reclaimed water which is used for aesthetic enjoyment or which otherwise serves a function not intended to include public contact.	Water shall be adequately disinfected and oxidized. Coliform not to exceed 23 MPN per 100 mL (based on the last 7 days for which analyses have been completed) at some point in the treatment process.
Groundwater Recharge	Reclaimed water used for recharge of domestic water supply aquifers by surface spreading.	Water shall be of a quality that is protective of public health. The California DHS will make recommendations to the RWQCB based on relevant aspects of each project, including treatment provided; effluent quality and quantity; spreading area operations; soil characteristics; hydrogeology; residence time; and distance to withdrawal.

Source: California Code of Regulations

Reclaimed Water Discharge

Reclaimed water discharges to surface waters (rivers, lakes and streams) are regulated under the Federal Clean Water Act and in California under the Porter-Cologne Water Quality Control Act (Porter-Cologne Act, California Water Code §13000 *et seq.*). The Porter-Cologne Act also addresses reclaimed water discharges that may affect groundwater quality. The Clean Water Act's broad objective is to "restore and maintain the chemical, physical, and biological integrity of the nation's waters." To meet this objective, the U.S. EPA has set up a system of permitting and licensing, the National Pollutant Discharge Elimination System (NPDES), to monitor and control reclaimed water discharges. In the study area, this system is administered by the State Water Resources Control Board (SWRCB) and the North Coast and San Francisco Bay Regional Water Quality Control Boards, which are part of the California EPA. Currently, the Laguna Plant releases reclaimed water into the Laguna de Santa Rosa during the winter months (1st October through 4th May) once the flow in the Russian River exceeds 1,000 cfs. These discharges are limited to one percent of the Russian River flow (with five percent allowed only by direct authorization by the North Coast Regional Board), but sometimes represent a much higher proportion of flow in the Laguna.

Publicly Owned Treatment Works (POTWs), such as the Laguna Plant, operate under the NPDES and must have an NPDES permit to discharge reclaimed water. The permit sets discharge requirements and specifies what chemicals the POTW must monitor. Because the Laguna Plant has a daily flow of more than five million gallons it is required to establish an industrial pretreatment program to control industrial discharges into the sewer system. The standards were established to prevent discharges that would interfere with the POTW's treatment equipment or operations or endanger personnel and to prevent discharges that could not be adequately treated before discharge by the POTW. The Laguna Plant's pretreatment program and other programs that have been developed to minimize the introduction of chemicals into the Laguna Plant are discussed in the Description of Existing System and Alternatives, Section 3.2. Industrial dischargers must pretreat their wastewater to standards set by the EPA and the State Water Resources Control Board.

Human Exposure to Reclaimed Water

The potential health impacts presented by the proposed release mechanisms (urban and agriculture irrigation, discharge to the Russian River or Laguna, and geysers injection) depend upon the concentrations of the chemical and biological constituents in the water and the pathways (inhalation, dermal contact, ingestion) via which individuals are exposed. The potential health impacts are evaluated in a human health risk assessment that has been prepared for the Project alternatives, (Parsons Engineering Science, Inc. 1996). This section summarizes the findings of that assessment.

Wastewater that arrives at the Laguna Plant is a mixture of domestic and municipal/ household wastes and industrial wastes that have received pretreatment. This wastewater contains both chemical (organic and inorganic) and biological (bacteria, viruses, and

parasites) constituents that must be removed to allow safe reuse or discharge of the water. The primary, secondary, and tertiary treatment processes at the Laguna Plant are capable of greatly reducing the chemical and biological constituents in the wastewater as it passes sequentially through these treatment processes. Water that is released from the Laguna Plant historically has contained low concentrations of chemical and biological constituents.

Chemical Constituents

About 30 inorganic and 200 organic chemicals have been analyzed in the Laguna Plant's undiluted effluent at least once between 1988 and 1995 (Merritt Smith Consulting 1996). Of these, 23 inorganic and 26 organic chemicals have been reported at or above their analytical detection limits in at least one sample (Table 4.6-1).

Nitrate and Nitrite

Of the reported chemicals in undiluted effluent, only nitrate and nitrite have occurred regularly (>90% of samples) and have both maximum and mean concentrations which exceed State and Federal drinking water standards and the human health criteria for noncarcinogenic health effects (Parsons Engineering Science, Inc. 1996). The primary health effect of elevated levels of nitrate and nitrite in drinking water is the induction of methemoglobinemia in infants (blue-baby syndrome). The drinking water standard and the health criteria are derived from human epidemiological studies that have reported health effects only at nitrate concentrations which exceed 10 mg/L nitrate (as nitrogen) in water. A small number of cases of methemoglobinemia has been reported in epidemiological studies for water containing 11 to 20 mg/L nitrate (as nitrogen) (coliform-contaminated well water may have been a complicating factor in these cases) although clinical studies have reported no clinical signs of methemoglobinemia for infants who received water containing up to 34.5 mg/L nitrate-nitrogen. The 10 mg/L drinking standard is therefore believed to be fully protective of human health.

Nitrate is found in municipal drinking water supplies within the Project area at concentrations of 2.0 mg/L nitrate (as nitrogen) or less (Table 4.7-2). Nitrate concentrations in groundwater within the Project area vary from non-detect up to a reported 72 mg/L in the Stemple Creek area near the Two Rock reservoir site and 12 mg/L near the Lakeville reservoir site (refer to Section 4.5, Groundwater).

Trihalomethanes

Chloroform and bromodichloromethane have been reported regularly (100% and 95% of samples, respectively) in the Laguna Plant's undiluted effluent. These two chemicals, along with dibromochloromethane, (which has been detected infrequently in less than 20% of samples) and bromoform (which has not been detected), are often referred to collectively as trihalomethanes. Trihalomethanes

are by-products of disinfection that form when water containing naturally-occurring organic matter is chlorinated to inactivate disease-causing microorganisms. Disinfection by-products are also commonly found in municipal drinking water systems when chlorine is used to disinfect during water treatment and to provide a residual chlorine level that will prevent microbiological growth in water pipelines. The average, combined concentration of trihalomethanes (0.0129 mg/L) in the Laguna Plant's effluent is similar to that found in the drinking water supplies of Santa Rosa, Petaluma and Rohnert Park (Table 4.7-2).

The historic concentrations of trihalomethanes in the undiluted effluent do not exceed the state or federal drinking water standard (0.100 mg/L). The average concentration in the undiluted Laguna Plant effluent represents an average excess cancer risk of between about one in one hundred thousand (1×10^{-5}) and one in a million (1×10^{-6}). This level of risk is within the acceptable cancer risk range (1×10^{-4} to 1×10^{-6}), which the EPA considers to be protective of human health when setting drinking water standards (U.S. EPA 1994).

Hormone Mimics/Disrupters

Recent scientific publications have suggested that some chemicals (sometimes described collectively as environmental estrogens, hormone mimics/disrupters, or environmental hormones) may be responsible for observed declines in the reproductive success and sexual development of wildlife and similar adverse health effects in humans (Parsons Engineering Science, Inc. 1995). Researchers have proposed that these chemicals may induce their effects by disrupting the metabolism or effects of the natural sex hormones of both males and females. Many of the chemicals that have been identified as potential hormone mimics or disrupters are chlorine-based chemicals such as dioxins, DDT, chlordane, lindane or polychlorinated biphenyls (PCBs), although non-chlorine chemicals (detergents, synthetic estrogens, and some metals) have been identified as well.

Several of the potential hormone mimics or disrupters have been reported at low concentrations in the undiluted effluent from the Laguna Plant. The reported chemicals include five pesticides (aldicarb, aldrin, endosulfan, lindane, and heptachlor), three phthalates (di-n-butyl phthalate, bis (2-ethylhexyl) phthalate, and diethyl phthalate), and three metals (cadmium, lead, and mercury). Generally, they have occurred infrequently (frequencies ranged from 1 of 91 samples to 2 of 4 samples) and at concentrations close to the detection limits of the analytical method (Table 4.6-1).

Because scientific research into this phenomenon is relatively recent, the EPA and other regulatory agencies have not developed new standards or adjusted existing standards to address the reproductive effects of these chemicals at low concentrations. Therefore, it is not currently possible, using existing standards and/or regulatory agency risk assessment methodology, to evaluate the

environmental hormone effects of these chemicals at the low concentrations reported in the Laguna Plant effluent.

Biological Constituents

Total coliform bacteria, heterotrophic bacteria, *Salmonella*, *Shigella*, *Legionella*, *Giardia*, *Cryptosporidium*, and enteric viruses were analyzed in samples collected from the Laguna Plant effluent and the Russian River (above the confluence with Mark West Creek) as part of this study in 1994. In addition, data for total coliform bacteria were obtained from the Laguna Plant's waste discharge permit records from 1991 to 1994.

Salmonella, *Shigella*, *Legionella*, and enteric viruses were not detected in any samples (Table 4.7-4). During the 1994 sampling event, total coliform bacteria were detected in one effluent sample (2 MPN/100 mL) and all four of the Russian River samples (23 to 240 MPN/100 mL). Individual samples recorded in the Laguna Plant's historical data contained coliform bacteria counts as high as 170 MPN/100 mL for one daily sample, but the monthly mean concentrations never exceeded 2 MPN/100 mL. *Giardia* cysts were detected only in the effluent during the late 1994 sampling event, although they have previously been detected in the Russian River (CH2M Hill 1993). *Cryptosporidium* oocysts were detected only in the Russian River.

Hazardous Materials/Waste

Releases of hazardous materials/wastes have the potential to adversely affect public health if they are encountered unexpectedly during the construction phase of the Project or if they impact Project elements during the Project lifetime. At the Federal level, the storage and handling of hazardous substances is regulated under the Resource Conservation and Recovery Act, which follows hazardous substances from "cradle to grave" and regulates hazardous waste generators; transporters; and treatment, storage, and disposal facilities. California has been authorized by the EPA to administer its own Resource Conservation and Recovery Act program. The cleanup of sites contaminated by releases of hazardous substances is regulated by the Comprehensive Environmental Response, Compensation and Liability Act of 1980 which was amended by the Superfund Amendment and Reauthorization Act of 1986.

Known hazardous waste release sites are subject to oversight by federal, state, and/or local agencies. Information about these sites, such as the site address, responsible party, types of contaminants and status of cleanup, is maintained in government agency files and databases. The agencies with potential oversight at sites in Sonoma County include the EPA; the Department of Toxic Substances Control within the California EPA; the North Coast and San Francisco Bay Regional Water Quality Control Boards; the Sonoma County Public Health Department, Environmental Health Services; and the local city and county fire departments.

Table 4.7-4

Historical Biological Constituents in the Laguna Plant Effluent and Russian River (1994)

Sample Type	Date	Total Coliform	Legionella	Salmonella	Shigella	Heterotrophic Bacteria	Giardia lamblia	Cryptosporidium	Enteric Virus
		MPN/100 mL				(CFU/1 mL)	(Cysts/100 L)	(Oocysts/100 L)	(PFU/Volume)
Fresh Effluent	27 Oct 94	< 2	ND	ND	ND	8	0	0	NA
Fresh Effluent	8 Nov 94	< 2	ND	ND	ND	21	0	0	NA
Fresh Effluent	30 Nov 94	2	ND	ND	ND	20	5.1	0	NA
Fresh Effluent	14 Dec 94	< 2	ND	ND	ND	18	13.8	0	< 1 / 129 L
Russian River	27 Oct 94	23	ND	ND	ND	166	NA	NA	0 / 22 L
Russian River	8 Nov 94	240	ND	ND	ND	31	0	2.7	NA
Russian River	30 Nov 94	30	ND	ND	ND	110	0	0	0 / 153 L
Russian River	14 Dec 94	220	ND	ND	ND	610	0	0.4	NA

Source: Parsons Engineering Science, Inc., *Human Health Risks from Chemical and Biological Components of Reclaimed Water* 1995

Notes:
- MPN = most probable number
- CFU = colony forming units
- ND = not detected
- PFU = plaque forming units
- NA = not analyzed
- < indicates the detection limit

Summary of Regulatory Agency Databases and List Review

The potential for encountering existing contamination from historical hazardous materials/waste releases can be evaluated by reviewing lists and databases compiled by regulatory agencies with oversight within the Project area. For purposes of this study the study area is defined as sites within a 1,000-foot wide corridor along the pipeline alignments and around pump station and reservoir sites (500 feet on a side) for state, local and most national listings and a one-mile wide corridor for sites on the National Priority List (also known as Superfund sites). A database search was conducted to identify sites that are included on fourteen different State and Federal regulatory agency databases (Environmental Risk Information & Imaging Services 1995). The environmental databases and lists, which are current to the listed date and were included in the search are found in Table 4.7-5. A total of 196 sites appeared on the regulatory agencies lists. The locations of these sites with respect to project elements are shown on Figures 4.7-1 and 4.7-2.

Typical sites include gas stations and other owners of underground storage tanks, solid waste landfills, businesses that use or store hazardous materials, and a variety of other operations that handle, generate, or store hazardous materials or hazardous wastes. Many sites appear on more than one database. Therefore, multiple listings must be considered when evaluating the number of releases, generators, handlers, and discharges of potentially hazardous substances or wastes. Review of the available regulatory agency databases revealed the following totals:

- 196 sites were identified within the Project area for the hazardous materials investigation;
- 19 sites were listed but had insufficient data to accurately plot their location in relation to the project alternatives, but were included in this study due to the potential for impact;
- 122 sites had registered or formerly registered underground storage tanks (UST, LUST and CORTESE lists);
- 72 sites have reported leaking underground storage tanks (LUST and CORTESE lists);
- 4 sites have been investigated or are under investigation by the EPA (CERCLIS database);
- 12 sites are active or inactive solid waste landfills or processing facilities of which two have reported a migration of hazardous waste (SWIS and SWAT databases);
- 65 sites were listed as generators or handlers of hazardous materials (HWIS and RCRIS databases);

Table 4.7-5

Environmental Data Bases and Lists

Data Base	Definition	Date
CALSITES	California Hazardous Waste Sites	May 1995
CERCLIS	Comprehensive Environmental Response Compensation and Liability Information System	May 1995
CORTESE	California Cortese List	September 1990
ERNS	Emergency Response Notification System	July 1994
FINDS	Facility Index System	March 1995
HWIS	California Hazardous Waste Information System	December 1993
LUST	California Leaking Underground Storage Tanks	January 1995
NFRAP	No Further Remedial Action Planned Sites	February 1995
NPL	National Priorities List	May 1995
RCRIS	Resource Conservation and Recovery Information System	November 1994
SWAT	California Solid Waste Assessment Test	June 1994
SWIS	California Solid Waste Information System	November 1994
TRI	Toxic Release Inventory	December 1992
UST	California Underground Storage Tanks	March 1994
WDS	California Waste Discharger System	February 1995

Source: Environmental Risk Information and Imagery Services , Environmental Database Search Summary Report 1995.

- 13 sites were listed as permitted to discharge wastewater or hazardous waste into either injection wells or surface water (WDS list);
- 2 sites have reported sudden and/or accidental release of hazardous substances into the environment (ERNS list); and
- No sites within one-half mile of the Project components appeared on the National Priorities List.

Each of the pipeline alignments was qualitatively evaluated for their potential to encounter soil and/or groundwater contamination during construction. The pipeline routes for the Discharge Alternatives do not have any reported releases or hazardous material handlers within 500 feet of the alignment and the probability of encountering environmental contamination during construction is considered low. The West County (16 sites), South County (17 sites), Sebastopol irrigation area (17 sites), and geysers (25 sites) pipeline routes have a moderate probability of encountering environmental contamination during construction based on the number of sites observed. The urban irrigation pipelines alignment has the highest probability of encountering environmental contamination, as a total of 86 sites are located within 500 feet of this route. Most sites listed in the regulatory agency databases are properties where a small to moderate volume of hazardous materials/wastes are used, stored, or generated and/or underground storage tank(s) containing petroleum hydrocarbons are present. These sites typically do not have widespread contamination except where the volume of the release is great and groundwater is shallow.

The location of pump stations with respect to contaminant release sites and hazardous material handlers are evaluated separately from the pipelines. Although the construction of pump stations would be slab on grade and most of the piping would be aboveground, surface and subsurface materials at these locations would be disturbed to some degree to accommodate installation or realignment of utilities and connections to the water pipelines. Six pump stations appear to be located within approximately 500 feet of hazardous materials/waste sites. Pump Stations WPBS-13 and WPBS-16 are located in the West County near Sites 49 and 75. Pump Station SBPS-7 is located near Site 55 in the South County. Pump Stations LBPS-1 and LBPS-2 are located near Sites 41 and 32 in the Sebastopol area. Pump Station PS-G2 is located near Site 4 along the geysers pipeline alignment. With the exception of Pump Station WPBS-16, the nearby hazardous materials/waste sites are underground storage tanks or leaking underground storage tank sites. Pump Station WPBS-16 is located near the Class III Sonoma County Landfill on Meacham Road.

Other Potential Sources of Contamination

Leaded gasolines have been used as vehicle fuels in the U.S. since the 1920s. Although lead has recently been removed from fuel formulations, leaded fuels are a recognized source of contamination in soils along roadways in urban areas (Madhaven et al. 1989). The proposed pipeline alignments intersect or parallel several freeways (State highways 112, 101, and 116) and other heavily trafficked routes. Surface and near-surface soils

(1)

LEGEND	
● 85	Site Numbers

scale: 1"=12,000'

Source: Parsons Engineering Science

HARLAND BARTHOLOMEW & ASSOCIATES, INC.
PARSONS ENGINEERING SCIENCE, INC.
UNITS OF PARSONS INFRASTRUCTURE & TECHNOLOGY INC.
PARSONS

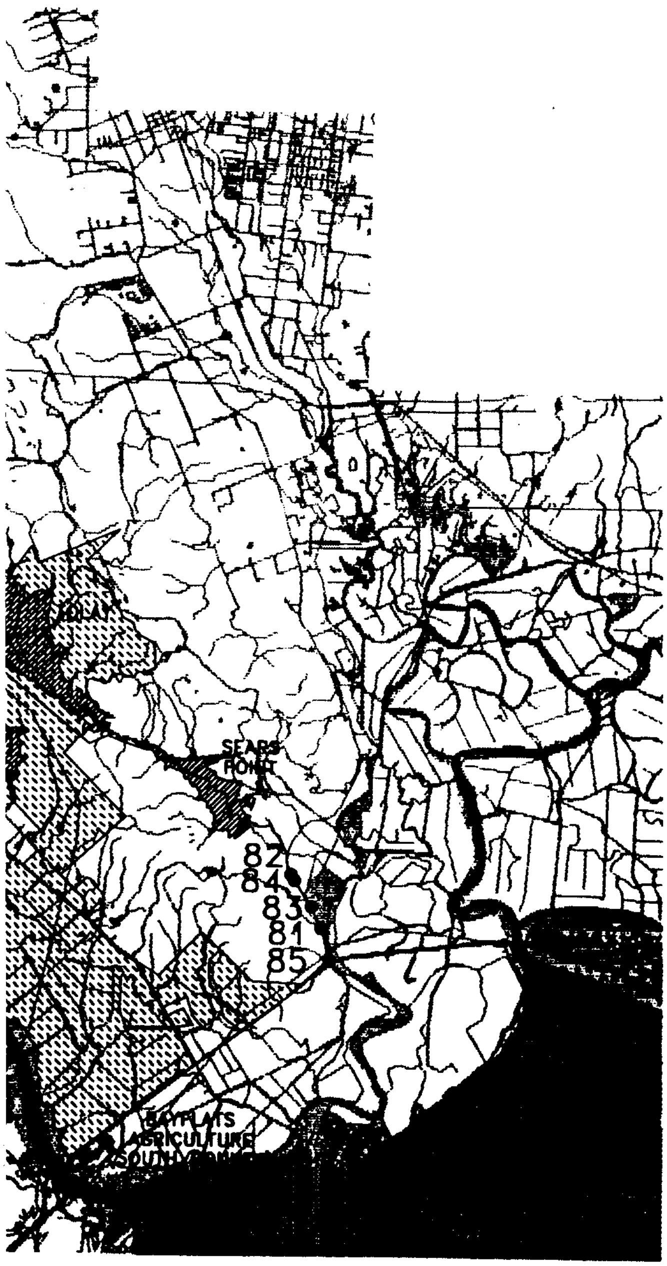
Santa Rosa

anta Rosa Subregional Long-Term Wastewater Project

REPORTED HAZARDOUS MATERIALS/WASTE SITES SOUTHERN PROJECT AREA

Figu

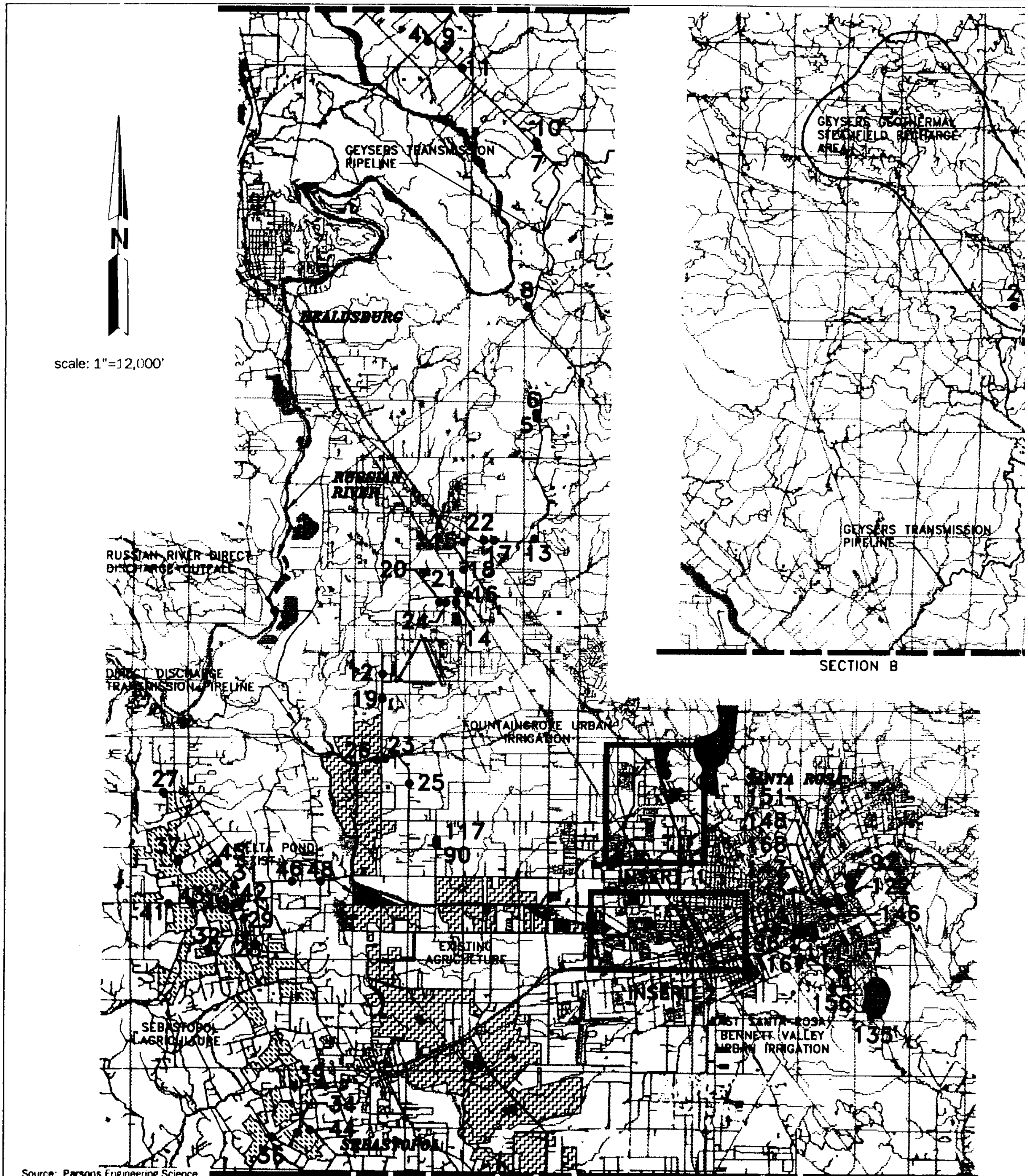
3



REPORTED HAZARDOUS MATERIALS/WASTE SITES SOUTHERN PROJECT AREA

Figure 4.7-1

(1)



Source: Parsons Engineering Science

HARLAND BARTHOLOMEW & ASSOCIATES, INC.

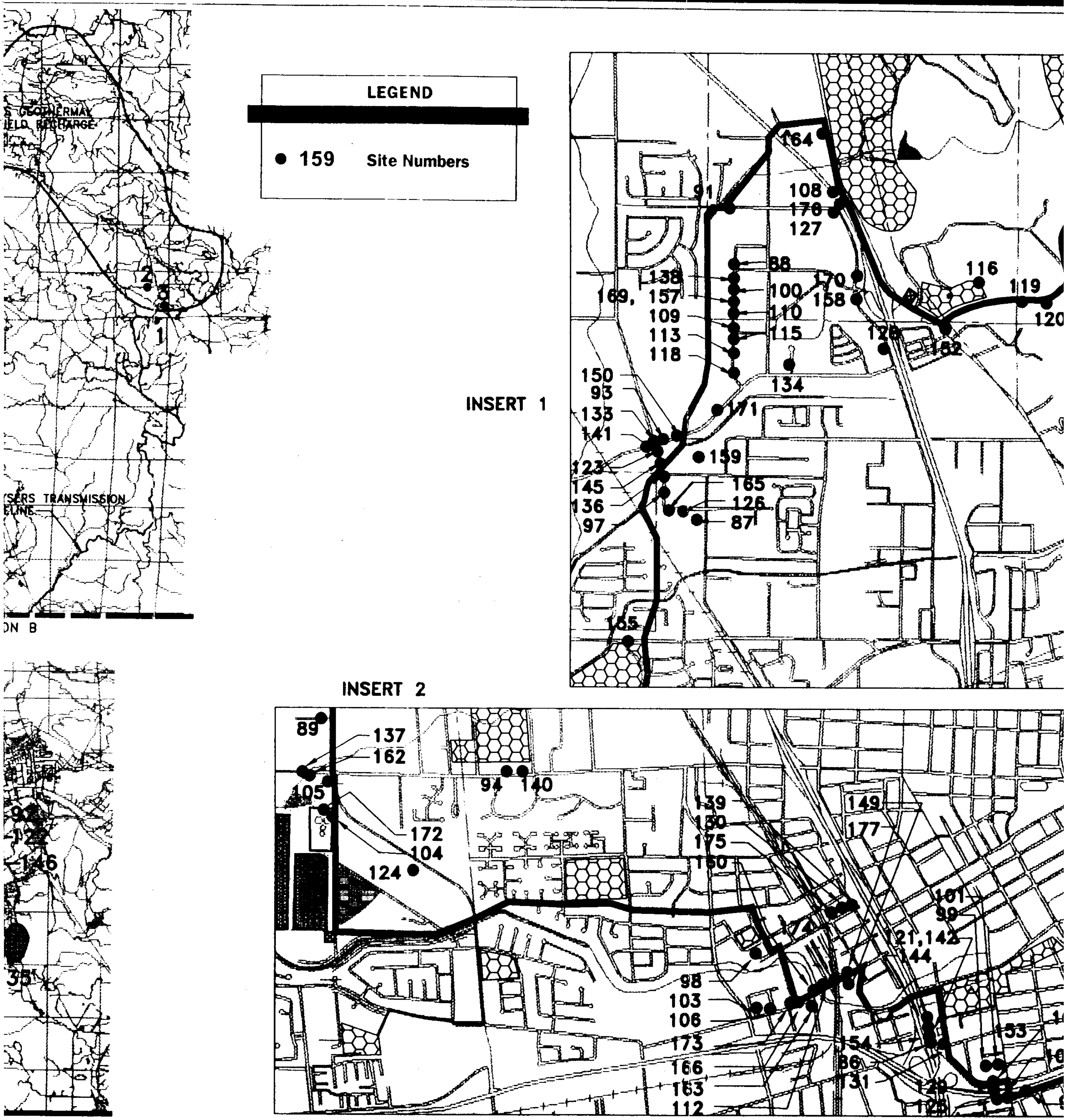
PARSONS ENGINEERING SCIENCE, INC.

UNITS OF PARSONS INFRASTRUCTURE & TECHNOLOGY INC.

PARSONS

Santa Rosa

(2)

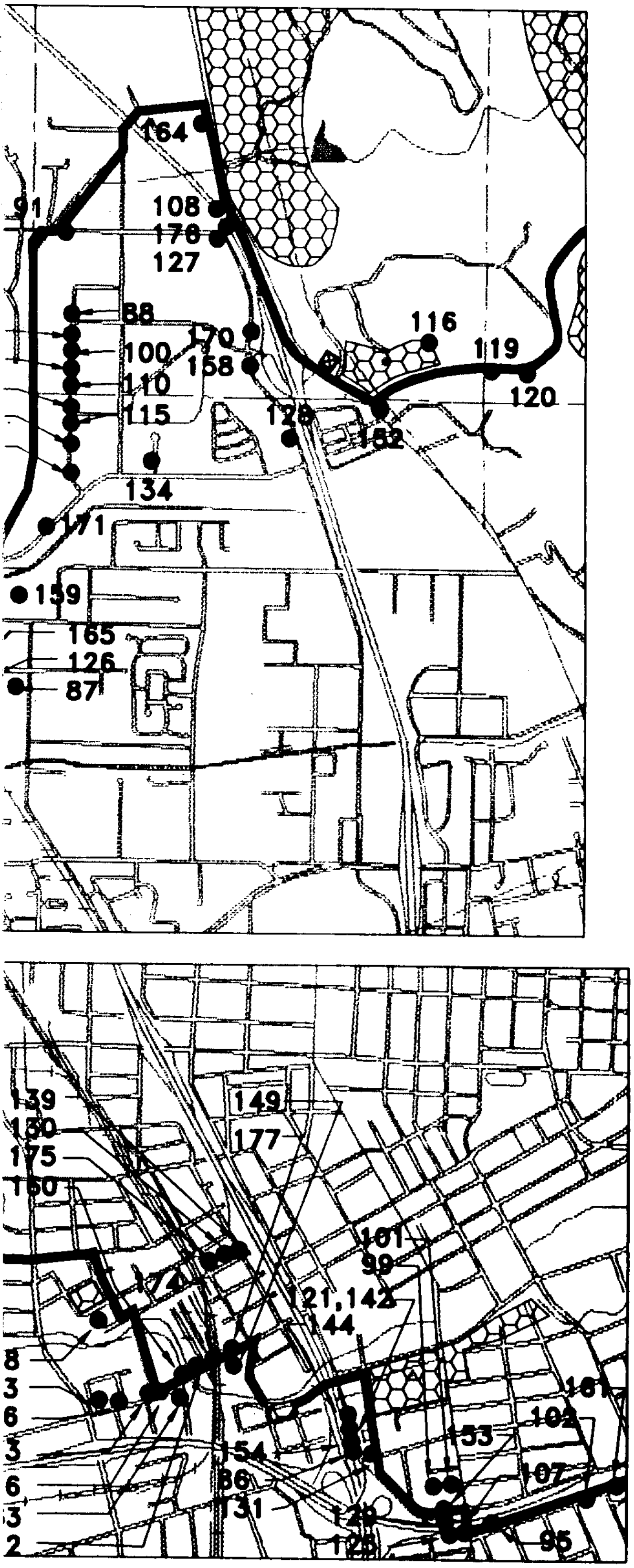


Santa Rosa
Subregional Long-Term
Wastewater Project

REPORTED HAZARDOUS MATERIALS/WASTE SITES NORTHERN PROJECT AREA

Fig

3



REPORTED HAZARDOUS MATERIALS/WASTE SITES NORTHERN PROJECT AREA

Figure 4.7-2

adjacent to these roadways have the potential to contain significant concentrations of lead (over 1,000 mg/kg) due to the deposition of lead compounds from vehicle exhausts.

Railroad rights-of-way are potential sources of environmental contamination because of undocumented spillage that may have occurred during the transport of chemicals. Pesticides, used to control plant growth or to preserve railroad ties, are another potential source of contamination along railroad rights-of-way. The West County, South County, urban irrigation, Russian River discharge, and Sebastopol irrigation pipeline alignments cross the Petaluma-Santa Rosa Railroad right-of-way. The South County, urban irrigation, and geysers pipeline alignments cross the Northwestern Pacific Railroad right-of-way.

Hazardous Materials Storage and Use

A variety of hazardous materials, including chlorine to disinfect wastewater, are currently used during operations at the Laguna Plant (City of Santa Rosa 1991). Additional hazardous materials, such as fuels, motor oils, paints, and compressed gases, would be used in construction. While these are commonly used materials, if handled improperly (fuels, for example, are flammable) they could endanger workers and the public.

State regulations require the operator of a business that uses hazardous materials to prepare a Hazardous Materials Management Plan (HMMP) to address the storage and handling of these materials and to be prepared to respond to the possible release of such materials. The plans are generally provided to fire departments to aid their response to emergencies at facilities which handle hazardous materials. HMMPs are intended to prevent or to mitigate damage from hazardous materials releases and therefore to minimize the safety and health hazards that these materials pose. The Laguna Plant has prepared separate HMMPs to address the storage and handling of hazardous materials during operation of the water reclamation plant and maintenance facilities. In addition, the reclamation plant has a Process Safety Plan that addresses the handling of chlorine (and other hazardous materials) during the daily operation of the plant.

The chlorine that is used for disinfection is stored in two, 40,000-pound bulk storage tanks at a pressure of 90 pounds per square inch (psi). At this pressure, chlorine is in a liquid state. Each tank is filled to a maximum level of 34,000 pounds, so the maximum amount of liquid chlorine that could be stored on site at any time would not exceed 68,000 pounds. The median daily chlorine use is about 3,000 pounds, with a range of 2,000 to 6,000 pounds per day. Use at this level requires new deliveries of liquid chlorine (by tank truck) about every twelve days.

From the storage tanks, liquid chlorine flows through pipes to evaporators where the liquid is vaporized to a gas. The gas flows under vacuum to chlorinators and then to metered injectors, which mix the chlorine with water just upstream of the contact tanks (or other processes that require chlorination). About 80% to 85% of the chlorine use is in the contact tanks and about 15% to 20% is in the headworks. Less than 2% is used for other processes.

The Laguna Plant has several safety features to prevent the release of chlorine gas to the atmosphere and to warn employees in the event that a release does occur. Chlorine detectors and alarms are installed near the chlorine storage tanks, the evaporators, and the chlorinators. In addition, the chlorination system has sensors to detect temperature, pressure, and water flow. Monitoring of these parameters is used to detect potential problems. Since the current system has been in use, there have been no releases of chlorine that would adversely affect public health.

Construction Hazards

Hazards associated with construction activities can affect the safety of both workers and the general public. The safety of workers is regulated by the California Occupational Safety and Health Administration, which receives its authority from Title 8 of the California Code of Regulations. These regulations also indirectly protect the general public by requiring construction managers to post warnings signs, to limit public access to construction areas, and to obtain permits for work considered to present a significant risk of injury (e.g., excavations greater than 5 feet into which a person is required to descend).

Where excavations or other Project activities would occur in public rights-of-way, an encroachment permit is required from the appropriate agency such as the California Department of Transportation for State highways, Departments of Public Works for roadways within cities, or the Sonoma County Department of Public Works or Office of Emergency Services for county roads (refer to Section 4.11, Transportation). These permits are designed to protect the public by providing a system of notification to providers of emergency or other important services of road closures. Compliance with these requirements would minimize the safety and health hazards associated with construction activities.

Flood Hazards

Flooding or inundation may occur when runoff from a watershed exceeds the capacity of the stream or river channel that drains the watershed or when water is released catastrophically from a dam failure. Impacts of the Project alternatives relative to flooding from excessive runoff are discussed in Surface Water Hydrology, Section 4.4. Risk of flooding as a result of dam failure is discussed in this Public Health and Safety section. Areas that would be inundated in the event of a dam break are evaluated in Section 4.19, Inundation from Dam Failure.

Vector Control

Mosquitoes are both pests and vectors of disease to humans and animals. Mosquito populations can increase rapidly, especially during the warmer summer months. Twenty-one species of mosquitoes are known to occur within the Project area. Several of these have the potential to breed and to reproduce as a result of the construction and operation of Project components (e.g., storage reservoirs and irrigation areas).

The California Health and Safety Code provides authority for mosquito abatement districts to advise and control mosquito production on private and public lands and to assess the land owner for the cost of that control. The districts also have the authority to hold hearings and assess civil penalties to abate nuisance and potential health threats to the general public (California Health and Safety Code, Sections 2270-2294). The Marin/Sonoma Mosquito Abatement District (Abatement District) and the Vector Biology and Control Branch of the California Department of Health Services are responsible for overseeing the mosquito prevention program within the Project area. The primary objective of the Abatement District is to suppress the mosquito population below the threshold level required for disease transmission or nuisance tolerance level.

The Abatement District has produced several documents addressing mosquitoes and other biting arthropods associated with wastewater reclamation or disposal projects. These documents provide project design criteria for mosquito prevention as well as guidelines for proper management of wastewater reclamation or disposal projects. The design criteria include minimizing the amount of over-irrigation, ponding, or tail water, thereby significantly reducing the need to treat these sites with pesticides and the subsequent need to provide the Abatement District with compensation for that control effort. These criteria are addressed in the Project design where new irrigated areas would be created (refer to the *Irrigation Management Guidelines*, Questa Engineering Corporation 1996).

Public Health and Safety Goals, Objectives, and Policies

Table 4.7-6 identifies goals, objectives, and policies which provide guidance for development in relation to potable water supplies and exposure to hazardous materials or waste. The table also indicates which criteria in the Public Health and Safety Section are responsive to each set of policies.

Table 4.7-6

General Plan Goals, Objectives, and Policies - Public Health and Safety

Adopted Plan Document	Document Section	Document Numeric Reference	Policy	Relevant Evaluation Criteria[1]
Sonoma County General Plan	Resource Conservation Element	Goal RC-3	Assure an adequate long term supply of water for domestic use	1
Sonoma County General Plan	Public Safety Element	Goal PS-4 Objective PS-4.2	Prevent unnecessary exposure of people and property to risks from hazardous materials, and regulate their transport, storage and use to reduce risks to acceptable levels	1

Table 4.7-6

General Plan Goals, Objectives, and Policies - Public Health and Safety

Adopted Plan Document	Document Section	Document Numeric Reference	Policy	Relevant Evaluation Criteria[1]
Marin Countywide Plan	Environmental Quality Element	Policy EQ-3.3	Radioactive, chemical and biological health hazards to humans or wildlife shall not be created, and existing levels shall be reduced	1,2,3
Santa Rosa General Plan	Public Facilities and Services Element	Goal PSF-9	Utilize high quality water from the Sonoma County Water Agency aqueduct system as the primary water supply	1
Santa Rosa General Plan	Safety Element	Goal S-6 Objective S-6a	Use existing regulations to identity and eliminate or mitigate existing or potential dangers from hazardous materials	2,3
Petaluma General Plan	Community Health and Safety Element	Objective (r)	Insure safe drinking water for all Petalumans	1
Petaluma General Plan	Community Health and Safety Element	Objective (l)	The city shall use Sonoma County's Hazardous Waste Management Plan to minimize the dangers from transport treatment and storage of hazardous waste	2,3
Sebastopol General Plan	Safety Element	Policy 11	Protect the water quality obtained from City wells	1
Sebastopol General Plan	Safety Element	Goal 8 Policy 34 Policy 36	Reduce hazards of transportation, storage and disposal of hazardous waste	2,3
Rohnert Park General Plan	Safety Element	Objective 4 Principle 5 Principle 6	Protect the community's health, safety, welfare, natural resources and property through regulation of authorized use, elimination of unauthorized use, storage, transport and disposal of hazardous materials with specific focus on problem prevention	2,3

Table 4.7-6

General Plan Goals, Objectives, and Policies - Public Health and Safety

Adopted Plan Document	Document Section	Document Numeric Reference	Policy	Relevant Evaluation Criteria[1]
Cotati General Plan	Quality of Life Section	Objective 7.5	Protect citizens from dangers related to the movement, storage and manufacture of hazardous materials	2,3
Windsor General Plan	Public Health and Safety Element	Policy E.1 Policy E.1.1 Policy E.1.3	Minimize potential health effects from the use, storage and disposal of hazardous materials and waste	2,3

Source: Harland Bartholomew and Associates, Inc., 1995

1 The evaluation criteria are in Table 4.7-7.

EVALUATION CRITERIA WITH POINT OF SIGNIFICANCE

The evaluation criteria for Public Health and Safety are based on standards promulgated by the State of California and goals, objectives, and/or policies of regional and local governments and special districts (Table 4.7-7).

Table 4.7-7

Evaluation Criteria with Point of Significance - Public Health and Safety

Evaluation Criteria	As Measured by	Point of Significance	Justification
1. Will the Project expose the public to chemicals, radionuclides, pathogenic viruses, bacteria, or other disease organisms at concentrations detrimental to human health?	Concentration of constituents in reclaimed water. Concentration of pathogens in reclaimed water.	Exceedence of State or Federal drinking water standards or human health-based criteria at a domestic water source, or State Department of Health Services standards for reclaimed water.	California Drinking Water and Reclaimed Water Regulations

Table 4.7-7

Evaluation Criteria with Point of Significance - Public Health and Safety

Evaluation Criteria	As Measured by	Point of Significance	Justification
2. Will the Project expose workers or the public to hazards from a known hazardous waste site?	Ground disturbance near a hazardous waste site(s).	Less than 500 feet	CEQA guidelines; Resource Conservation and Recovery Act; Comprehensive Environmental Response Compensation and Liability Act
3. Will the Project increase potential exposure of the public to hazardous materials due to a chemical release?	Increase in use or storage of hazardous materials not in accordance with State and Federal hazardous materials or waste regulations.	Greater than 0 occurrences	California and Federal Hazardous Materials/Waste Regulations; Public Safety sections of local General Plans
4. Will the Project expose the public to safety hazards associated with operation of heavy machinery, vehicles, or equipment; or creation of accessible excavations (trenches, pits, or borings); or creation of an accessible open body of water?	Use of heavy machinery, vehicles or equipment; creation of excavations; or creation of an open body of water in public areas not in accordance with State construction safety regulations.	Greater than 0 occurrences	California Construction Safety Regulations (see text)
5. Will the Project expose the public to a flooding hazard?	Increased hazard due to construction not in accordance with state and federal regulations.	Greater than 0 houses and facilities affected	Public Safety sections of local General Plans
6. Will the Project increase the potential exposure of the public to disease vectors (i.e., mosquitoes)?	Creation of mosquito habitat.	Greater than 0 acres of new mosquito habitat	Marin/Sonoma Mosquito Abatement District criteria for mosquito abatement

Source: Parsons Engineering Science, Inc. 1996

The evaluation criteria and points of significance were developed as discussed below.

Water Use, Reuse, and Discharge

The water use, reuse, and discharge evaluation criteria are based on numeric standards MCLs promulgated in the State of California's drinking water regulations and risk-based numbers calculated using formulae derived by the California Department of Toxic Substances Control. An MCL has been set for many organic and inorganic chemicals and for radionuclides in domestic water supplies delivered by Public Water Systems. Risk-based criteria are being used to evaluate chemicals for which an MCL has not been promulgated and to evaluate potential exposure to reclaimed water via pathways other than domestic water use.

For potential exposures other than domestic water use, the concentrations of chemicals and microorganisms in reclaimed water are evaluated in the context of California Department of Health Services standards governing water reclamation.

Chemicals and Radionuclides

Information about background water quality and quality of project-related inflows (direct discharge to the Russian River and storage reservoir "leakage") is used to estimate the Project impact on domestic water quality. Estimated water quality will be compared directly to MCLs (Table 4.7-8). If a Project alternative would cause the water quality at a domestic water intake to exceed an MCL, then the impact would be considered significant.

Some chemicals do not have a promulgated MCL but may potentially produce adverse human health effects and thus have significant effects. One purpose of the human health risk assessment is to identify such effects. Recent data are used to estimate the human health risk from exposure to reclaimed water via feasible exposure pathways in addition to domestic water consumption (e.g., consumption of fish, exposure to irrigation water, exposure during water recreation activities) unless the current and proposed treatment plant upgrades are expected to change effluent quality.

Environmental Estrogens

The current scientific literature suggests that a large number of the man-made, industrial, and agricultural chemicals that have been released into the environment over the past 50 years have the potential to disrupt the endocrine system of terrestrial and aquatic life. State and federal MCLs are available for many of these potential environmental estrogens, however, the MCLs are based on adverse health effects of these chemicals other than their potential estrogenic effects. The estrogenic effects of these chemicals may occur at higher or lower concentrations than the MCLs. It is therefore inappropriate to evaluate a chemical's potential estrogenic effects based on the MCLs.

No data are presently available in the scientific literature concerning threshold levels (i.e., the lowest environmental concentrations in soil, air or water) that may

induce estrogenic effects in humans. These data would be needed to evaluate the chemical levels found to date in Project reclaimed water. Due to the unavailability of scientific data, an evaluation criterion for environmental estrogens was not developed.

Pathogenic Viruses, Bacteria and other Disease Organisms

The drinking water criteria for coliforms are more stringent than the reclaimed water criteria. A Public Water System is in violation of the total coliform MCL for drinking water when more than 5 percent of the samples collected during any month are total coliform-positive (for water systems that collect at least 40 samples per month) or more than one sample collected during any month is total coliform-positive (for water systems that collect less than 40 samples per month). Retesting of the water supply must not be positive for fecal coliform or *E. coli*. If the Project alternatives would cause the water quality at a domestic water intake to exceed these requirements, then the impact would be considered significant.

The California Department of Health Services has established treatment requirements for a variety of reclaimed water uses (Title 22, CCR §60301 *et seq.*). These requirements are believed to be capable of reducing pathogenic constituents to acceptable levels. The California Department of Health Services has proposed changes to the existing regulations and submitted these changes for public review and comment. These revisions have not been formally adopted, but are currently being used as guidance by some regulatory agencies, such as the Regional Water Quality Control Boards (Regional Boards) (Hulquist 1996).

The most stringent regulations in Title 22 currently require secondary treatment of wastewater plus the advanced treatment processes of coagulation, clarification, filtration, and disinfection. As of May 1996, the level of disinfection required depends upon the ultimate use of the water but the most restrictive requirement (for nonrestricted recreational impoundments and spray irrigation) is a median coliform level that does not exceed 2.2 MPN per 100 mL and a maximum coliform level that does not exceed 23 MPN/100 mL more than once in a 30-day period. Filtration must produce turbidity of 2 turbidity units of less.

Table 4.7-8

Summary of Primary and Secondary Maximum Contaminant Levels

Chemical/Constituent	State (mg/L)	Federal (mg/L)	Chemical/Constituent	State (mg/L)	Federal (mg/L)
PRIMARY MCLs			1,1-Dichloroethane	0.005	N/A
INORGANICS			1,2-Dichloroethane	0.0005	0.005
Aluminum	1	N/A	1,1-Dichloroethylene	0.006	0.007
Antimony	0.006	0.006	cis-1,2-Dichloroethylene	0.006	0.07
Arsenic	0.05	0.05	trans-1,2-Dichloroethylene	0.01	0.1
Asbestos	7 MFL[1]	7 MFL[1]	Dichloromethane	0.005	0.005
Barium	1	2	1,2-Dichloropropane	0.005	0.005
Beryllium	0.004	0.004	1,3-Dichloropropylene	0.0005	N/A
Cadmium	0.005	0.005	Ethylbenzene	0.7	0.7
Chromium	0.05	0.1	Monochlorobenzene	0.07	0.1
Copper	1.3[2]	1.3[2]	Styrene	0.1	0.1
Cyanide	0.2	N/A	1,1,2,2-Tetrachloroethane	0.001	N/A
Lead	0.015[2]	0.015[2]	Tetrachloroethylene	0.005	0.005
Mercury	0.002	0.002	Toluene	0. 15	1
Nickel	0.1	0.1	1,2,4-Trichlorobenzene	0.07	0.07
Nitrate[3]	10	10	1,1,1-Trichloroethane	0.2	0.2
Nitrate + Nitrite[3]	10	10	1,1,2-Trichloroethane	0.005	0.005
Nitrite[3]	1	1	Trichloroethylene	0.005	0.005
Selenium	0.05	0.05	Trichlorofluoromethane	0.15	N/A
Thallium	0.002	0.002	1,1,2-Trichloro-1,2,2-Trifluoroethane	1.2	N/A
			Trihalomethanes	0.1	0.1
ORGANICS			Vinyl Chloride	0.0005	0.002
Volatiles			Xylenes	1.750[4]	10
Benzene	0.001	0.005			
Carbon Tetrachloride	0.0005	0.005	**Non-Volatiles**		
1,2-Dichlorobenzene	0.6	0.6	Alachlor	0.002	0.002
1,4-Dichlorobenzene	0.005	0.075	Atrazine	0.003	0.003
Non-Volatiles (continued)			Polychlorinated Biphenyls	0.0005	0.0005
Bentazon	0.018	N/A	Simazine	0.004	0.004
Benzo(a)pyrene	0.0002	0.0002	Thiobencarb	0.07	N/A
Carbofuran	0.018	0.04	Toxaphene	0.003	N/A
Chlordane	0.0001	0.002	2,3,7,8-TCDD (Dioxin)	3 X 10^{-8}	3 X 10^{-8}
2,4-D	0.07	0.07	2,4,5-TP (Silvex)	0.05	0.05
Dalapon	0.2	0.2			

Table 4.7-8

Summary of Primary and Secondary Maximum Contaminant Levels

Chemical/Constituent	State (mg/L)	Federal (mg/L)	Chemical/Constituent	State (mg/L)	Federal (mg/L)
Dibromochloropropane	0.0002	0.0002	**RADIOACTIVITY[5]**	**(pCi/L)**	
Di(2-ethylhexyl)adipate	0.4	0.4	Radium-226 and Radium-228	5	N/A
Di(2-ethylhexyl)phthalate	0.004	0.006	Gross Alpha particle activity[6]	15	N/A
Dinoseb	0.007	0.007	Tritium	20,000	N/A
Diquat	0.02	0.02	Strontium-90	8	N/A
Endothall	0.1	0.1	Gross Beta particle activity	50	N/A
Endrin	0.002	0.002	Uranium	20	N/A
Ethylene Dibromide	0.00005	0.00005			
Glyphosate	0.7	0.7	**SECONDARY MCLs**		
Heptachlor	0.00001	0.0004	Aluminum	N/A	0.05-0.2
Heptachlor Epoxide	0.00001	0.0002	Chloride	250	250
Hexachlorobenzene	0.001	0.001	Copper	1.0	1.0
Hexachlorocyclopentadiene	0.05	0.05	Iron	0.3	0.3
Lindane	0.0002	0.0002	Manganese	0.05	0.05
Methoxychlor	0.04	0.04	Silver	N/A	0.1
Molinate	0.02	N/A	Sulfate	250	250
Oxamyl	0.2	0.2	Total Dissolved Solids	500	500
Pentachlorophenol	0.001	0.001	Zinc	5	5
Picloram	0.5	0.5			

Source: California Code of Regulations, Federal Code of Regulations

Notes:

(1) MFL = million fibers per liter; MCL for fibers exceeding 10 μm in length.
(2) Action level.
(3) As nitrogen.
(4) MCL as either an isomer or a sum of isomers.
(5) pCi/L, picoCuries per liter.
(6) Includes radium-226 but not radon and uranium. Gross alpha particle measurement may be substituted for measurement of radium-226 and radium-228.

Hazardous Materials/Waste

The hazardous materials/waste criterion is based on the CEQA requirement that lead agencies consult the lists of hazardous waste sites compiled pursuant to Section 65962.5 of the California Government Code to determine whether the proposed Project alternatives are located on a site which is included on any of the lists. The lists are

compiled by the Regional Water Quality Control Boards, the California Department of Toxic Substances Control, and the California Integrated Waste Management Board.

While CEQA only requires that the Project alternative be examined for hazardous waste issues, a distance of 500 feet was selected to ensure that nearby properties do not have hazardous waste contamination issues that may affect or that may be affected by the proposed project alternatives.

Hazardous Materials Storage and Use

The hazardous materials storage and use criterion is based on the requirements of the Public Safety Sections of local General Plans, which list goals, objectives, and/or policies for reducing potential damage from hazardous materials. These requirements are derived from State regulations (e.g., California Health and Safety Code §25500 *et seq.*) which require local agencies such as fire departments to administer programs for storing and handling of hazardous materials.

Construction Hazards

The criteria for safety hazards during construction are based on safety regulations (Title 8, CCR §1500 to §1938) regarding construction sites. While the regulations have been promulgated to protect workers in the construction industry, the Project alternatives have components, such as pipelines, that may be built in areas accessible to the public. The criteria have been developed to protect the public in areas where they may encounter construction activities.

Flooding Hazards

The criterion for flooding is based on information contained in the Public Safety sections of local General Plans. The plans generally recognize the importance of reducing the potential hazard due to flooding as might occur from dam failure and inundation. Most General Plans within the project area do not directly refer to dam failure and subsequent inundation in policy statements or goals, but do identify the protection of human life and resources from potential flooding hazards.

Vector Control

The criterion for disease vectors is based on the requirements of the Marin/Sonoma Mosquito Abatement District and the Vector Biology and Control Branch of the California Department of Health Services, which are responsible for overseeing the mosquito prevention program within the Project area. The Abatement District has issued criteria for mosquito prevention in wastewater reclamation or disposal projects.

METHODOLOGY

Water Use, Reuse, and Discharge

The potential human health impacts from exposure to reclaimed water are evaluated by comparing the concentration of the chemical and biological components in historical data from reclaimed water from the Laguna Plant with California and Federal regulatory standards for public drinking water supplies and California regulatory requirements for the use of reclaimed water, and by evaluating the chemical and biological components in a human health risk assessment using guidelines published by the California EPA, Department of Toxic Substances Control.

Exposure Pathways

Potential pathways of exposure to the chemicals and microorganisms in reclaimed water include domestic use of water for drinking and bathing, recreational use, irrigation use, and consumption of fish that have contacted reclaimed water (Table 4.7-9). Most exposure pathways (consumption of fish is a possible exception) would result in dilution, filtration, or degradation of the constituents in the soil, surface water, or groundwater prior to human exposure. Because concentrations are already low (i.e., below drinking water standards) for most chemicals and microorganisms in reclaimed water, these environmental fate processes are expected to further reduce the potential exposure for these constituents. However, in areas that are near potential reservoir sites environmental fate processes may not be adequate to protect the health of persons using water from nearby wells if nitrate levels in reclaimed water remain at their historic concentrations (refer to Section 4.6, Groundwater).

For some chemicals (e.g., pesticides, mercury) even extremely low concentrations in water or sediments have the potential to bioaccumulate in fish tissue to concentrations high enough to pose health risks to fish consumers. This exposure pathway was examined in the human health risk assessment by comparing water concentrations to EPA water quality criteria for ingestion of aquatic organisms and water; by evaluating data from bioaccumulation/magnification studies performed in 1991 and 1994 at the Kelly Farm Demonstration Wetland; and by applying the EPA's methodology for fish advisories to data collected for the State's Toxic Substances Monitoring Program. Although maximum and/or mean concentrations of some chemicals exceeded the EPA's water quality criteria, no level of bioaccumulation that would present a human health risk was found in animal data collected at Kelly Pond, or in the Russian River or Mark West Creek downstream of the Laguna Plant's current discharge point (Parsons Engineering Science, Inc. 1995).

Table 4.7-9

Summary of Possible Exposure Pathways

Pathway	Comments
Russian River to Domestic Water Supply	Potentially complete pathway; Russian River flows will dilute discharge; Groundwater will dilute discharge; Discharge occurs for a maximum of 7.5 months per year
Fish Consumption	Potentially complete pathway; Animal data indicate that this pathway is not significant
Recreational Use	Potentially complete pathway; Discharge occurs during portion of year when swimming and wading uses are low; Fishers protected by clothing
Urban and Agricultural Irrigation	Potentially complete pathway; Orders of magnitude smaller exposure than domestic water use scenario; Ingestion discouraged by State-mandated posting of warning signs and design requirements
Storage Ponds	No probable complete pathway; Ponds are fenced and public access is restricted
Reservoirs to Domestic Water Supply	Potentially complete pathway; Groundwater dilution of nitrates may not be adequate at some reservoir sites
Geyser Injection	No probable complete pathway; Closed system of pipes and tanks; Water injected in excess of 3,000 feet below ground surface

Source: Parsons Engineering Science, Inc. February 1996

Toxicity Assessment and Risk Characterization

Hazard quotients are used to evaluate the noncarcinogenic health effects of the chemical components. A hazard quotient of less than 1.0 indicates that a chemical is not expected to produce an adverse health effect. Excess cancer risks are used to evaluate carcinogenic health effects of the chemical components. In general, excess cancer risks greater than one in a million (1×10^{-6}) to one in one-hundred thousand (1×10^{-5}) are considered by the State of California to pose a significant threat to human health (Title 22, California Code of Regulations, §12703). For this assessment the lower excess cancer risk of 1.0×10^{-6} is used as a screening level for carcinogenic health effects. This is the most health-protective value.

The analysis of risk from the detected biological components in the Laguna Plant effluent is evaluated by comparing the data to a known infective dose (*Giardia*), to background concentrations (total coliform and heterotrophic bacteria), and to regulatory standards (total coliform).

Chemical and biological components that do not pass the screen are examined further and are evaluated as to their environmental fate (chemical or biological degradation), attenuation (loss of viability in the case of pathogens), filtration, dilution by groundwater or surface water, background concentrations, and

comparison to state and federal drinking water standards (Maximum Contaminant Limits, MCLs) and reclaimed water standards.

Fish Consumption

Water quality and organismal data from the Kelly Farm Pond bioaccumulation study and from the Regional Water Quality Control Board's Toxic Substances Monitoring Program on the Russian River are used to evaluate the potential human health hazard associated with the consumption of fish. Water quality data are compared to water quality criteria proposed by the U.S. EPA for the combined consumption of aquatic organisms and water and for the consumption of aquatic organisms alone. Organismal data are examined to evaluate whether chemicals are bioaccumulating in the food web.

The following technical reports were used in the evaluation of potential Project impacts:

- *Human Health Effects and Wildlife Effects of Environmental Estrogens* (Parsons Engineering Science, Inc. 1995); and
- *Human Health Risks from Chemical and Biological Components of Reclaimed Water* (Parsons Engineering Science, Inc. 1995).

Hazardous Materials/Waste

The potential human health impacts from exposure to hazardous materials/waste from uncontrolled releases of hazardous materials are evaluated by compiling a list of reported hazardous materials or hazardous waste sites within 500 feet of pipeline alignments.

Hazardous Materials Storage and Use

The potential human health impacts from exposure to hazardous materials used during Project construction or operation are evaluated by comparing proposed uses with California and Federal regulations regarding the storage and use of hazardous materials.

Construction Hazards

The potential safety impacts from hazards associated with construction activities are evaluated in the context of California and federal regulations.

Flood Hazards

Potential risk for dam failure was analyzed in the context of compliance with regulations that are in place to ensure that the public is protected from flooding hazards. These include regulations of the Division of Safety of Dams and the Office of Emergency Services. Additional information regarding analysis of potential inundation areas downstream of reservoirs is presented in Section 4.19.

Vector Control

The potential human health impacts from exposure to mosquitoes are evaluated by identifying Project components that may increase potential mosquito habitat. Practices regarding irrigation water use are evaluated to determine whether they would comply with Marin/Sonoma County Mosquito Abatement District and Department of Health Services, Vector Control Branch guidelines.

ENVIRONMENTAL CONSEQUENCES (IMPACTS) AND RECOMMENDED MITIGATION

No Action Alternative

Table 4.7-10

Public Health and Safety Impacts by Component - No Action Alternative

Evaluation Criteria	As Measured by	Impact	Type of Impact[1]	Level of Significance[2]
7.1.1. Will the No Action Alternative expose the public to chemicals, radionuclides, pathogenic viruses, bacteria, or other disease organisms, at concentrations detrimental to human health?	Exceedence of State or Federal drinking water standards or human health-based criteria at a domestic water source, or DHS standards for reclaimed water.	Does not exceed standards	O&M	O
7.1.2. Will the No Action Alternative expose workers or the public to hazards from a known hazardous waste site?	Ground disturbance within 500 feet of a hazardous waste site(s).	None	C	==
7.1.3. Will the No Action Alternative increase potential exposure of the public to hazardous materials due to a chemical release?	Any increase in use or storage of hazardous materials not in accordance with state and federal hazardous materials/waste regulations	None	C, O&M	==
7.1.4. Will the No Action Alternative expose the public to safety hazards associated with operation of heavy machinery, vehicles, or equipment; or creation of accessible excavations or creation of an accessible open body of water?	Use of heavy machinery, vehicles or equipment; creation of excavations; or creation of an open body of water in public areas not in accordance with State construction safety regulations.	None	C, O&M	==

Table 4.7-10

Public Health and Safety Impacts by Component - No Action Alternative

Evaluation Criteria	As Measured by	Impact	Type of Impact[1]	Level of Significance[2]
7.1.5. Will the No Action Alternative expose public to a flooding hazard?	Increased hazard due to construction not in accordance with state and federal regulations.	None	P	=
7.1.6. Will the No Action Alternative increase the potential exposure of the public to disease vectors (i.e., mosquitoes)?	Greater than 0 acres of new mosquito habitat	None	O&M	=

Source: Parsons Engineering Science, Inc., 1996

Notes: 1. Type of Impact:
C Construction
O&M Operation and Maintenance
P Permanent

2. Level of Significance codes:
O Less than significant impact; no mitigation proposed
= No impact

Impact: **7.1.1. Will the No Action Alternative expose the public to chemicals, radionuclides, pathogenic viruses, bacteria, or other disease organisms at concentrations detrimental to human health?**

Analysis: *Less than Significant; Alternative 1.*

See Impact 7.9.1 in this section for a discussion of impacts from discharge of reclaimed water.

Mitigation: No mitigation is proposed.

Impact: **7.1.2 - 5. Will the No Action Alternative impact public health and safety based on evaluation criteria 1 through 5?**

Analysis: *No Impact; Alternative 1.*
The No Action alternative will have no effect on public health and safety because there will be no construction activity.

Mitigation: No mitigation is needed.

Headworks Expansion Component

Table 4.7-11

Public Health and Safety Impacts by Component - Headworks Expansion

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
7.2.1. Will the headworks expansion component expose the public to chemicals, radionuclides, pathogenic viruses, bacteria, or other disease organisms, at concentrations detrimental to human health?	Exceedence of State or Federal drinking water standards or human health-based criteria at a domestic water source, or DHS standards for reclaimed water.	--	O&M	--
7.2.2. Will the headworks expansion component expose workers or the public to hazards from a known hazardous waste site?	Ground disturbance within 500 feet of a hazardous waste site(s).	None	C	==
7.2.3. Will the headworks expansion component increase potential exposure of the public to hazardous materials due to a chemical release?	Any increase in use or storage of hazardous materials not in accordance with State and Federal hazardous materials/waste regulations	Increase in accordance with State and Federal haz mat/waste regulations	O&M	O
7.2.4. Will the headworks expansion component expose the public to safety hazards associated with operation of heavy machinery, vehicles, or equipment; or creation of accessible excavations; or creation of an accessible open body of water?	Use of heavy machinery, vehicles or equipment; creation of excavations; or creation of an open body of water in public areas not in accordance with State construction safety regulations.	None	C, O&M	==
7.2.5. Will the headworks expansion component expose public to a flooding hazard?	Increased hazards due to construction not in accordance with state and federal regulations.	None	P, O&M	==

Table 4.7-11

Public Health and Safety Impacts by Component - Headworks Expansion

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
7.2.6. Will the headworks expansion component increase the potential exposure of the public to disease vectors (i.e., mosquitoes)?	Greater than 0 acres of new mosquito habitat	None	O&M	==

Source: Parsons Engineering Science, Inc., 1996

Notes: 1. Type of Impact:
C Construction
O&M Operation and Maintenance
P Permanent

2. Level of Significance codes:
O Less than significant impact; no mitigation proposed
-- Not Applicable
== No impact

Impact: **7.2.1, 2, 4, 5, 6. Will the headworks expansion component impact public health and safety based on evaluation criteria 1, 2, 4, 5, and 6?**

Analysis: *No Impact; All Alternatives.*

The headworks expansion would not release any reclaimed water to the environment.

Although the Laguna Plant appears on several hazardous material lists, the new pumps will be built inside an existing building and installation activities will not affect or be affected by hazardous materials/wastes issues at the plant.

Alternative 1 does not have a headworks expansion component.

Mitigation: No mitigation is needed.

Impact: **7.2.3. Will the headworks expansion component increase potential exposure of the public to hazardous materials due to a chemical release?**

Analysis: *Less than Significant; Alternatives 2, 3, 4, and 5.*

Some increased use of liquid chlorine will be expected if the capacity of the headworks is increased. If increased use were roughly proportional to the increase in flow (use is also dependent on total solids in the waste stream) from 18 to 21 mgd, the median daily use will increase to about 3,500 pounds. However, the maximum weight of chlorine that could be

stored on site (68,000 pounds) will not change. The increased daily usage will result in a small increase in the required frequency of tank truck deliveries from the current rate of one delivery about every 12 days (assuming that the tank truck volumes remain the same) to about one delivery every 10 days.

Existing monitoring and alarm systems and safety procedures as described in the Laguna Plant's Process Safety Plan will remain in place and will provide protection against accidental releases and exposure to the public. All storage and use will be in accordance with governing state and federal regulations.

The current Laguna Plant Hazardous Materials Management Plan addresses the storage and handling of chlorine and other hazardous materials during the operation of the water reclamation plant and maintenance facilities. Because of the increased yearly usage of chlorine at the plant, the Hazardous Materials Management Plan will require updating to reflect this change.

No Impact; Alternative 1.

This alternative does not have a headworks component.

Mitigation: *Alternatives 2, 3, 4, and 5.*

2.3.14. Update Existing Hazardous Materials Management Plan.

Alternative 1. No mitigation is needed.

After Mitigation: *Less than Significant after Mitigation; Alternatives 2, 3, 4, and 5.*

Annual updates of the Hazardous Materials Management Plan for chlorine storage and use at the Laguna Plant will mitigate potential impacts.

Urban Irrigation Component

Table 4.7-12

Public Health and Safety Impacts by Component - Urban Irrigation

Evaluation Criteria	As Measured by	Impact	Type of Impact[1]	Level of Significance[2]
7.3.1. Will the urban irrigation component expose the public to chemicals, radionuclides, pathogenic viruses, bacteria, or other disease organisms, at concentrations detrimental to human health?	Exceedence of State or Federal drinking water standards or human health-based criteria at a domestic water source, or DHS standards for reclaimed water.	Does not exceed standards	O&M	○

Table 4.7-12

Public Health and Safety Impacts by Component - Urban Irrigation

Evaluation Criteria	As Measured by	Impact	Type of Impact[1]	Level of Significance[2]
7.3.2. Will the urban irrigation component expose workers or the public to hazards from a known hazardous waste site?	Ground disturbance within 500 feet of a hazardous waste site(s).	None	C	==
7.3.3. Will the urban irrigation component increase potential exposure of the public to hazardous materials due to a chemical release?	Any increase in use or storage of hazardous materials not in accordance with state and federal hazardous materials/waste regulations	None	C, O&M	==
7.3.4. Will the urban irrigation component expose the public to safety hazards associated with operation of heavy machinery, vehicles, or equipment; or creation of accessible excavations or creation of an accessible open body of water?	Use of heavy machinery, vehicles or equipment; creation of excavations; or creation of an open body of water in public areas not in accordance with State construction safety regulations.	None	C, O&M	==
7.3.5. Will the urban irrigation component expose public to a flooding hazard?	Increased hazard due to construction not in accordance with state or federal regulations.	None	P	==
7.3.6. Will the urban irrigation component increase the potential exposure of the public to disease vectors (i.e., mosquitoes)?	Greater than 0 acres of new mosquito habitat	None	O&M	==

Source: Parsons Engineering Science, Inc., 1996

Notes: 1. Type of Impact:
C Construction
O&M Operation and Maintenance
P Permanent

2. Level of Significance codes:
O Less than significant impact; no mitigation proposed
== No impact

Impact: **7.3.1. Will the urban irrigation component expose the public to chemicals, radionuclides, pathogenic viruses, bacteria, or other disease organisms, at concentrations detrimental to human health?**

Analysis: *Less than Significant; Alternatives 2 and 3.*

These alternatives irrigate urban areas, potentially including business parks, golf courses, parks and schools, in the Fountaingrove and Bennett Valley areas. These facilities currently irrigate with potable water.

Replacement of potable water with reclaimed water potentially could expose persons using these facilities to any chemicals or microorganisms in reclaimed water via inhalation, dermal absorption, or inadvertent ingestion of spray irrigation. If harmful chemicals or microorganisms are present at high enough concentrations they may induce adverse health effects. The potential for these adverse effects has been evaluated in a human health risk assessment (Parsons Engineering Science, Inc. 1995).

The human health risk assessment quantitatively assessed the health risk from domestic use (e.g., drinking, showering, washing) of undiluted reclaimed water based on historic chemical and biological data for the Laguna Plant effluent. Exposure to the chemicals and microorganisms in reclaimed water via contact with irrigation water was evaluated qualitatively but not quantified. This approach was taken because the potential uptake of chemicals or microorganisms from exposure to irrigation water would be much smaller than potential uptake via exposure to reclaimed water in a domestic use scenario, which includes ingestion, inhalation, and dermal contact with reclaimed water. Chemicals that do not present an adverse health risk under the domestic use scenario would not present an adverse health risk under the urban irrigation scenario.

In the domestic use scenario, nitrate and nitrite are the only compounds that exceed California and federal drinking water standards and the human health criteria. The nitrate concentrations in reclaimed water will be similar to a very weak solution of fertilizer, and they do not present a significant health risk from irrigation. Ingestion during irrigation exposure (possibly of a few milliliters on an irregular basis) will be less than ingestion in the domestic exposure, which assumes a person drinks 2 liters of water per day.

Microorganism concentrations (coliform bacteria) are below levels set by the State for reclaimed water use for spray irrigation. In addition, the concentrations of *Giardia lamblia* do not present an unacceptable risk based on the EPA's risk criterion as stated in the Surface Water Treatment Rule and calculated in the human health risk assessment. No other pathogenic microorganisms (*Cryptosporidium*, *Legionella*, *Salmonella*, *Shigella*, or enteric viruses) were detected in the Laguna Plant effluent.

The potential for adverse health effects from reclaimed water is also controlled by State regulations which restrict the use of reclaimed water for irrigation in areas where food is handled and drinking water fountains are located (22 CCR 60310). The State requires all publicly accessible areas where reclaimed water is used to be posted with conspicuous signs that include the warning, "RECLAIMED WATER - DO NOT DRINK." The Project will comply with these regulations and with guidance for system design and maintenance, labeling, and operation as described in the *Urban Irrigation Management Guidelines* (Questa Engineering Corporation. 1996). Water that is to be used for spray irrigation is

required by the California Department of Health Services to be adequately disinfected, oxidized, coagulated, clarified, and filtered wastewater, with a coliform count not to exceed 2.2 most probable number (MPN) per 100 mL (based on the last 7 days for which analyses have been completed) at some point in the treatment process (Table 4.7-2). The total number of coliform cannot exceed 23 per 100 mL in more than one sample within a 30-day period.

No Impact; Alternatives 1, 4, and 5.

These alternatives do not have an urban irrigation component.

Mitigation: No mitigation is proposed.

Impact: 7.3.2, 3, 4, 5, 6. Will the urban irrigation component impact public health and safety based on evaluation criteria 2, 3, 4, 5, and 6?

Analysis: *No Impact; All Alternatives.*

The urban irrigation component involves no construction of facilities. There is no flood hazard associated with urban irrigation.

Alternatives 1, 4, and 5 do not have an urban irrigation component.

Mitigation: No mitigation is needed.

Pipeline Component

Table 4.7-13

Public Health and Safety Impacts by Component - Pipelines

Evaluation Criteria	As Measured by	Impact	Type of Impact[1]	Level of Significance[2]
7.4.1. Will the pipeline component expose the public to chemicals, radionuclides, pathogenic viruses, bacteria, or other disease organisms, at concentrations detrimental to human health?	Exceedence of State or Federal drinking water standards or human health-based criteria at a domestic water source, or DHS standards for reclaimed water.	Does not exceed standards	O&M	○
7.4.2. Will the pipeline component expose workers or the public to hazards from a known hazardous waste site?	Ground disturbances within 500 feet of hazardous waste site(s).	Yes	C	⊙

Table 4.7-13

Public Health and Safety Impacts by Component - Pipelines

Evaluation Criteria	As Measured by	Impact	Type of Impact[1]	Level of Significance[2]
7.4.3. Will the pipeline component increase potential exposure of the public to hazardous materials due to a chemical release?	Any increase in use or storage of hazardous materials not in accordance with state and federal hazardous materials/waste regulations.	None	C, O&M	==
7.4.4. Will the pipeline component expose the public to safety hazards associated with operation of heavy machinery, vehicles, or equipment; or creation of accessible excavations; or creation of an accessible open body of water?	Use of heavy machinery, vehicles or equipment; creation of excavations; or creation of an open body of water in public areas not in accordance with State construction safety regulations.	None	C, O&M	==
7.4.5. Will the pipeline component expose the public to a flooding hazard?	Increased hazard due to construction not in accordance with state and federal regulations.	None	P	==
7.4.6. Will the pipeline component increase the potential exposure of the public to disease vectors (i.e., mosquitoes)?	Greater than 0 acres of new mosquito habitat.	None	O&M	==

Source: Parsons Engineering Science, Inc., 1995

Notes: 1. Type of Impact:
C Construction
O&M Operation and Maintenance
P Permanent

2. Level of Significance codes:
⊙ Significant impact before mitigation; less than significant impact after mitigation
○ Less than significant impact; no mitigation proposed
== No impact

Impact: **7.4.1. Will the pipeline component expose the public to chemicals, radionuclides, pathogenic viruses, bacteria, or other disease organisms, at concentrations detrimental to human health?**

Analysis: *Less than Significant; Alternatives 2, 3, 4, and 5A.*

Neither construction nor operation of the pipelines will release reclaimed water to the environment. Therefore, there will be no exposure to the public.

Temporary exposure of the public to runoff from a pipe rupture could result in similar impacts as those described under urban irrigation, but for a very brief time period. These impacts include exposure to reclaimed water at levels in excess of the MCL for nitrate, however, the limited duration, pathways of exposure, and quantity ensures that such impacts will be less than significant.

No Impact; Alternatives 1 and 5B.

These alternatives do not have a pipeline component.

Mitigation: No mitigation is proposed.

Impact: 7.4.2. Will the pipeline component expose workers or the public to hazards from a known hazardous waste site?

Analysis: *Significant; Alternatives 2, 3, 4, and 5A.*

Construction of all of the pipelines may be affected by nearby releases of hazardous materials/wastes. Construction could be affected both by identified hazardous waste sites, and potentially by soil contamination associated with major transportation corridors (highways and railroad rights-of-way). The pipeline-related construction activities that may potentially be impacted by releases of hazardous materials include clearing and grubbing, trench excavations, installation or realignment of underground utilities, and boring and jacking operations. These activities will require soil excavation and possibly dewatering, which may expose or otherwise encounter hazardous materials/wastes. Specific project impacts resulting from encountering hazardous materials/wastes during pipeline construction include potential exposure of workers or the public to toxic chemicals in the environment, further contamination of environmental media, and project schedule delays and budgetary impacts as a result of characterization, removal, and/or disposal of hazardous materials/wastes encountered.

The potential pathways of exposure during the construction phase include dermal contact with contaminated soil and/or groundwater and inhalation through exposure to vapors migrating through the soils and into trenches. Impacts to environmental media could occur through the influence of dewatering systems on local contaminated plumes and the excavation of soil, which will provide a low-pressure zone that may attract migrating vapor phase contaminants.

No Impact; Alternatives 1 and 5B.

These alternatives do not have a pipeline component.

Mitigation: *Alternatives 2, 3, 4, and 5A.*

2.3.15. Construction Management Program

Alternatives 1 and 5B. No mitigation is needed.

After Mitigation: *Less than Significant after Mitigation; Alternatives 2, 3, 4, and 5A.*

Proper management of any contaminated soil encountered during construction will mitigate impacts to a less than significant level.

Impact: 7.4.3. Will the pipeline component increase potential exposure of the public to hazardous materials due to a chemical release?

Analysis: *No Impact; All Alternatives.*

Any hazardous materials used in construction or operation of the pipelines will be used and stored in accordance with state and federal regulations regarding hazardous materials.

Alternatives 1 and 5B do not have a pipeline component.

Mitigation: No mitigation is needed.

Impact: 7.4.4. Will the pipeline component expose the public to safety hazards associated with operation of heavy machinery, vehicles, or equipment; or creation of accessible excavations, or the creation of an accessible open body of water?

Analysis: *No Impact; All Alternatives.*

Construction of pipelines will utilize heavy machinery, vehicles, and equipment. All such equipment will be operated in accordance with state regulations regarding construction safety. There are no proposed construction equipment or techniques which will be unsafe if safety regulations are followed.

Construction of pipelines will create excavations within public rights-of-way. However, all excavations will be protected from the public at all times and constructed in accordance with state regulations regarding construction safety. There are no proposed excavations which will be unsafe if safety regulations are followed. No new water bodies will be created because of pipeline construction or operation.

Alternatives 1 and 5B do not have a pipeline component.

Mitigation: No mitigation is needed.

Impact: 7.4.5. Will the pipeline component expose the public to a flooding hazard?

Analysis: *No Impact; All Alternatives.*

The analysis of potential flooding from a pipeline rupture is presented in Surface Water Hydrology under Impact 4.4.7. The only facility which will be impacted by the pipe rupture is the road in which it is located. In the event of an earthquake, the primary impact on the road will be due to ground shaking or rupture rather than a pipeline break.

Alternatives 1 and 5B do not have a pipeline component.

Mitigation: No mitigation is proposed.

Impact: 7.4.6. Will the pipeline component increase the potential exposure of the public to disease vectors (i.e., mosquitoes)?

Analysis: *No Impact; All Alternatives.*

Neither construction nor operation and maintenance of the pipelines will create an open body of water where mosquitoes could breed.

Any ponding created from a pipeline rupture will be temporary and will not exist long enough to support mosquitoes or other disease vectors.

Alternatives 1 and 5B do not have a pipeline component.

Mitigation: No mitigation is needed.

Storage Reservoir Component

Table 4.7-14

Public Health and Safety Component Impacts - Storage Reservoirs

Evaluation Criteria	As Measured by	Impact	Type of Impact[1]	Level of Significance[2]
7.5.1. Will the storage reservoir component expose the public to chemicals, radionuclides, pathogenic viruses, bacteria, or other disease organisms, at concentrations detrimental to human health?	Exceedence of State or Federal drinking water standards or human health-based criteria at a domestic water source, or DHS standards for reclaimed water.	Yes; nitrate	P	⊙
7.5.2. Will the storage reservoir component expose workers or the public to hazards from a known hazardous waste site?	Ground disturbance within 500 feet of a hazardous waste site(s).	None	C	=

Table 4.7-14

Public Health and Safety Component Impacts - Storage Reservoirs

Evaluation Criteria	As Measured by	Impact	Type of Impact[1]	Level of Significance[2]
7.5.3. Will the storage reservoir component increase potential exposure of the public to hazardous materials due to a chemical release?	Any increase in use or storage of hazardous materials not in accordance with state and federal hazardous materials/waste regulations.	None	C O&M	==
7.5.4. Will the storage reservoir component expose the public to safety hazards associated with operation of heavy machinery, vehicles, or equipment; or creation of accessible excavations or creation of an accessible open body of water?	Use of heavy machinery, vehicles or equipment; creation of excavations; or creation of an open body of water in public areas not in accordance with State construction safety regulations.	None	C O&M	==
7.5.5. Will the storage reservoir component expose the public to a flooding hazard?	Increased hazard due to construction not in accordance with state and federal regulation.	No	P	==
7.5.6. Will the storage reservoir component increase the potential exposure of the public to disease vectors (i.e., mosquitoes)?	Greater than 0 acres of new mosquito habitat.	Greater than 0 acres	O&M	⊙

Source: Parsons Engineering Science, Inc., 1996

Notes: 1. Type of Impact:
C Construction
O&M Operation and Maintenance
P Permanent

2. Level of Significance codes:
○ Less than significant impact; no mitigation proposed
⊙ Significant impact before mitigation; less than significant impact after mitigation
== No impact

Impact: **7.5.1. Will the storage reservoir component expose the public to chemicals, radionuclides, pathogenic viruses, bacteria, or other disease organisms, at concentrations detrimental to human health?**

Analysis: *Significant; Alternatives 2 and 3.*

Seepage from reservoirs may result in levels of nitrate in private water supply wells that exceed maximum contaminant limits for drinking water.

Refer to Groundwater Section 4.5, evaluation criteria 1 and 2 for additional discussion.

No Impact; Alternatives 1, 4 and 5.

These alternatives do not have a storage reservoir component.

Mitigation: *Alternatives 2 and 3.*

2.3.12. Provide replacement water supply for affected wells.

Alternatives 1, 4, and 5. No mitigation is needed.

After Mitigation: *Less than Significant after Mitigation; Alternatives 2 and 3.*

Replacement water supply will mitigate public health impacts.

Impact: 7.5.2. Will the storage reservoir component expose workers or the public to hazards from a known hazardous waste site?

Analysis: *No Impact; All Alternatives.*

No potential hazardous waste sites were identified within 500 feet of any reservoir site. The Two Rock reservoir site is over a half mile from the existing landfill footprint of the Sonoma County Central Disposal Site. Because the landfill site is also separated from the reservoir by a drainage divide, groundwater analyses have determined that the reservoir will not be affected by any possible contamination from the landfill. Given the lack of any reported hazardous waste sites and that reservoirs are located in rural, upland areas, it is unlikely that hazardous waste issues at these sites will impact public safety.

Alternatives 1, 4, and 5 do not have a storage reservoir component.

Mitigation: No mitigation is needed.

Impact: 7.5.3. Will the storage reservoir component increase potential exposure of the public to hazardous materials due to a chemical release?

Analysis: *No Impact; All Alternatives.*

Any hazardous materials used in the construction or operation of the storage reservoirs will be stored and used in accordance with state and federal regulations regarding hazardous materials.

Alternatives 1, 4, and 5 do not have a storage reservoir component.

Mitigation: No mitigation is needed.

Impact: **7.5.4. Will the storage reservoir component expose the public to safety hazards associated with operation of heavy machinery, vehicles, or equipment; or creation of an accessible excavations; or creation of an accessible open body of water?**

Analysis: *No Impact; All Alternatives.*

Potential reservoir sites are located in rural areas with limited public access. General construction site safety procedures that limit public access (e.g., fencing) will further limit public access. Because the properties on which the reservoirs are located will be permanently fenced, public access to reservoirs will be limited during their operation and will not impact public safety. Heavy machinery and excavations will exist during construction but will be used in accordance with state construction safety regulations.

Alternatives 1, 4, and 5 do not have a storage reservoir component.

Mitigation: No mitigation is needed.

Impact: **7.5.5. Will the storage reservoir component expose the public to flooding hazard?**

Analysis: *No Impact; All Alternatives.*

All reservoirs will be created by damming a natural drainage or valley by means of an earth-filled embankment dam. Some reservoirs will include a smaller back/dam or saddle dams which will isolate a portion of the drainage area or adjoining drainage areas from the reservoir.

The design and construction of the reservoirs shall adhere to standards set by the California Department of Water Resources Division of Safety of Dams. The Division of Safety of Dams believes that adherence to these design and construction standards greatly reduces the probability of dam failure and is protective of public safety (Head 1996). During operation, the reservoirs will be visually inspected on a regular basis to ensure that the embankments, control structures, access roads, and monitoring instrumentation are maintained. All impediments will be removed from the spillway and other control structures as soon as they are observed.

Historically, earthen dams most often fail because an unusually heavy rain causes overtopping of the dam or because undetected surface or internal erosion, deformation, or sliding has weakened the dam. Contributing factors in these failures are improper siting, a lack of maintenance and monitoring, or inappropriate modification to an older structure (Jansen 1988). Maintenance, surveillance, and preparedness for emergencies are recognized as important activities that insure the safety of dams. With implementation of these measures, the risk of dam failure is estimated to be less than significant. Additional information regarding design of dams to withstand failure, and case histories of other dam failures in California is presented in Section 4.19. Although failure is extremely unlikely, the

California Office of Emergency Services requires preparation of an inundation map and development of a downstream evacuation plan for areas within the potential inundation area (California Water Code §6002, and California Government Code §8589.5). This requirement is discussed in Chapter 2, Measure 2.2.14, Dam Safety.

Alternatives 1, 4, and 5 do not have a storage reservoir component.

Mitigation: No mitigation is proposed.

Impact: 7.5.6. Will the storage reservoir component increase the potential exposure of the public to disease vectors (i.e., mosquitoes)?

Analysis: *Significant; Alternatives 2 and 3.*

The impoundment of water will create potential habitat for mosquitoes. Shallow reservoirs with a large surface area to volume ratio, such as Tolay, will be more likely to create mosquito habitat than deeper reservoirs. Reservoirs with irregular shorelines will also be more likely to create mosquito habitat. Reservoirs will generally be filled during the winter and early spring and emptied during the summer as water is withdrawn for irrigation. Thus, potential mosquito habitat will be created by the reservoirs from the beginning of the rainy season (November) through late summer (September).

No Impact; Alternatives 1, 4 and 5.

These alternatives do not have a storage reservoir component.

Mitigation: *Alternatives 2 and 3.*

2.3.16 Mosquito Prevention Program

Alternatives 1, 4 and 5. No mitigation is needed.

After Mitigation: *Less than Significant after Mitigation; Alternatives 2 and 3.*

Mosquito abatement measures will reduce impacts to less than significant.

Pump Station Component

Table 4.7-15

Public Health and Safety Impacts by Component - Pump Stations

Evaluation Criteria	As Measured by	Impact	Type of Impact[1]	Level of Significance[2]
7.6.1. Will the pump station component expose the public to chemicals, radionuclides, pathogenic viruses, bacteria or other disease organisms, at concentrations detrimental to human health?	Exceedence of State or Federal drinking water standards or human health-based criteria at a domestic water source, or DHS standards for reclaimed water.	None	O&M	==
7.6.2. Will the pump station component expose workers or the public to hazards from a known hazardous waste site?	Ground disturbance within 500 feet of a hazardous waste site(s).	Yes	C	⊙
7.6.3. Will the pump station component increase potential exposure of the public to hazardous materials due to a chemical release?	Any increase in use or storage of hazardous materials not in accordance with state and federal hazardous materials/waste regulations.	None	C, O&M	==
7.6.4. Will the pump station component expose the public to safety hazards associated with operation of heavy machinery, vehicles, or equipment; or creation of accessible excavations; or creation of an accessible open body of water?	Use of heavy machinery, vehicles or equipment; creation of excavations; or creation of an open body of water in public areas not in accordance with State construction safety regulations.	None	C, O&M	==
7.6.5. Will the pump station component expose the public to a flooding hazard?	Increased hazard due to construction not in accordance with state and federal regulations.	None	P	==
7.6.6. Will the pump station component increase the potential exposure of the public to disease vectors (i.e., mosquitoes)?	Greater than 0 acres of new mosquito habitat.	None	O&M	==

Source: Parsons Engineering Science, Inc., 1996

Notes: 1. Type of Impact:

C Construction

O&M Operation and Maintenance

P Permanent

2. Level of Significance codes:

⊙ Significant impact before mitigation; less than significant impact after mitigation

-- Not Applicable

== No impact

Impact: **7.6.1, 5, 6. Will the pump station component affect public health and safety based on evaluation criteria 1, 5 and 6?**

Analysis: *No Impact; All Alternatives.*

There will be no reclaimed water released to the environment or to open bodies of water; therefore no exposure to reclaimed water, flooding, or mosquito habitat will occur.

Mitigation: No mitigation is needed.

Impact: **7.6.2. Will the pump station component expose workers or the public to hazards from a known hazardous waste site?**

Analysis: *Significant; Alternatives 2, 3 and 4.*

Construction of the pump stations may be affected by nearby releases of hazardous materials/wastes. The pump station-related construction activities that may potentially be impacted by releases of hazardous materials include clearing and grubbing, excavations, and installation or realignment of underground utilities. These activities will require soil excavation and possibly dewatering, which may expose or otherwise encounter hazardous materials/wastes. Specific Project impacts resulting from encountering hazardous materials/wastes during pump stations construction include potential exposure of workers to toxic chemicals in the environment, further contamination of environmental media, and Project schedule delays and budgetary impacts as a result of characterization, removal, and/or disposal of hazardous materials/wastes encountered.

The potential pathways of exposure to workers during the construction phase include dermal contact with contaminated soil and/or groundwater and inhalation of vapors migrating through the soil and into trenches. Impacts to environmental media could occur through the influence of dewatering systems on local contaminated plumes and the excavation of soil which would provide a low-pressure zone that may attract migrating vapor phase contaminants.

No Impact; Alternatives 1 and 5.

These alternatives do not have a pump station component.

Mitigation: *Alternatives 2, 3, and 4.*

2.3.15. Construction Management Program

Alternatives 1 and 5. No mitigation is needed.

After Mitigation: *Less than Significant after Mitigation; Alternatives 2, 3, and 4.*

Appropriate soil management will reduce impacts to less than significant.

Impact: **7.6.3. Will the pump station component increase potential exposure of the public to hazardous materials due to a chemical release?**

Analysis: *No Impact; All Alternatives.*

Any hazardous materials used in the construction or operation of the pump stations will be stored and used in accordance with state and federal regulations regarding hazardous materials.

Alternatives 1 and 5 do not have a pump station component.

Mitigation: No mitigation is needed.

Impact: **7.6.4. Will the pump station component expose the public to safety hazards associated with operation of heavy machinery, vehicles, or equipment; or creation of excavations; or creation of an accessible open body of water?**

Analysis: *No Impact; All Alternatives.*

Pump stations will be constructed adjacent to transmission pipelines in areas that are generally accessible to the public. Although heavy equipment (e.g., backhoes, excavators, trucks) will be used to construct the pumping stations, general construction safety practices such as site fencing or barricades will protect the public from these hazards during construction activities. Construction activities will not impact public safety.

Alternatives 1 and 5 do not have a pump station component.

Mitigation: No mitigation is needed.

Agricultural Irrigation Component

Table 4.7-16

Public Health and Safety Impacts by Component - Agricultural Irrigation

Evaluation Criteria	As Measured by	Impact	Type of Impact[1]	Level of Significance[2]
7.7.1. Will the agricultural irrigation component expose the public to chemicals, radionuclides, pathogenic viruses, bacteria or other disease organisms, at concentrations detrimental to human health?	Exceedence of State or Federal drinking water standards or human health-based criteria at a domestic water source, or DHS standards for reclaimed water.	Does not exceed standards	O&M O&M-CP	○ ○
7.7.2. Will the agricultural irrigation component expose workers or the public to hazards from a known hazardous waste site?	Ground disturbance within 500 feet of a hazardous waste site(s).	Yes	C	⊙
7.7.3. Will the agricultural irrigation component increase potential exposure of the public to hazardous materials due to a chemical release?	Any increase in use or storage of hazardous materials not in accordance with state and federal hazardous materials/waste regulations.	None	C, O&M	==
7.7.4. Will the agricultural irrigation component expose the public to safety hazards associated with operation of heavy machinery, vehicles, or equipment; or creation of accessible excavations or creation of an accessible open body of water?	Use of heavy machinery, vehicles or equipment; creation of excavations; or creation of an open body of water in public areas not in accordance with State construction safety regulations.	None	C, O&M	==
7.7.5. Will the agricultural irrigation component expose the public to a flooding hazard?	Increased hazard due to construction not in accordance with state and federal regulations.	None	P	==

Table 4.7-16

Public Health and Safety Impacts by Component - Agricultural Irrigation

Evaluation Criteria	As Measured by	Impact	Type of Impact[1]	Level of Significance[2]
7.7.6. Will the agricultural irrigation component increase the potential exposure of the public to disease vectors (i.e., mosquitoes)?	Greater than 0 acres of new mosquito habitat.	Temporary	O&M	○

Source: Parsons Engineering Science, Inc., 1996

Notes:	1. Type of Impact:		2. Level of Significance codes:
C	Construction	⊙	Significant impact before mitigation; less than significant impact after mitigation
O&M	Operation and Maintenance	○	Less than significant impact; no mitigation proposed
P	Permanent	=	No impact

Impact: **7.7.1. Will the agricultural irrigation component expose the public to chemicals, radionuclides, pathogenic viruses, bacteria, or other disease organisms, at concentrations detrimental to human health?**

Analysis: *Less than Significant; Alternatives 2 and 3.*

Alternatives 2 and 3 propose an expansion of existing agricultural irrigation areas. About 18,000 acres of privately owned potential agricultural irrigation property is included in the West County area, 2,500 acres in the Sebastopol area, and 15,000 acres in the South County area. Of this total potential acreage, about 3,800 to 6,500 acres, depending upon the alternative, will actually be required. The irrigation season typically runs from March through November although there is a winter irrigation program which can be implemented as part of the Contingency Plan during dry winters.

Use of reclaimed water for agricultural irrigation via spray or drip methods (flood and furrow irrigation will not be used) could expose persons to any chemicals or microorganisms in reclaimed water via inhalation, dermal absorption, or inadvertent ingestion of spray irrigation or residues on crops. Persons could also be temporarily exposed to ponded reclaimed water from an accidental release; pipe break or over watering. If harmful chemicals or microorganisms are present at high enough concentrations they may induce adverse health effects. The potential for these adverse effects has been evaluated in a human health risk assessment (Parsons

Engineering Science, Inc. 1996). This analysis was summarized above under Impact 7.3.1 for urban irrigation. Public health issues of agricultural irrigation are essentially the same as those for urban irrigation.

No Impact; Alternatives 1, 4 and 5.

These alternatives do not have an agricultural irrigation component.

Mitigation: No mitigation is proposed.

Impact: 7.7.2. Will the agricultural irrigation component expose workers or the public to hazards from a known hazardous waste site?

Analysis: *Significant; Alternatives 2 and 3.*

Several hazardous materials/waste sites have been identified within 500 feet of agriculture irrigation areas.

No Impact; Alternatives 1, 4 and 5.

These alternatives do not have an agricultural irrigation component.

Mitigation: *Alternatives 2 and 3.*

2.3.15. Construction Management Program

Alternatives 1, 4, and 5. No mitigation is needed.

After Mitigation: *Less than Significant after Mitigation; Alternatives 2 and 3.*

Appropriate soil management will reduce impacts to less than significant.

Impact: 7.7.3. Will the agricultural irrigation component increase potential exposure of the public to hazardous materials due to a chemical release?

Analysis: *No Impact; All Alternatives.*

Any hazardous materials used in the construction or operation of the agricultural irrigation areas will be stored and used in accordance with state and federal regulations regarding hazardous materials.

Alternatives 1, 4, and 5 do not have and agricultural irrigation component.

Mitigation: No mitigation is needed.

Impact: 7.7.4. Will the agricultural irrigation component expose the public to safety hazards associated with operation of heavy machinery, vehicles, or equipment; creation of accessible excavations; or creation of an accessible open body of water?

Analysis: *No Impact; All Alternatives.*

Agricultural irrigation facilities will be constructed in areas that are generally not accessible to the public. General construction safety

practices such as site fencing, barricades, or signage will protect the public from these hazards during construction activities. Construction activities will not impact public safety.

Alternatives 1, 4, and 5 do not have and agricultural irrigation component.

Mitigation: No mitigation is needed.

Impact: 7.7.5. Will the agricultural irrigation component expose the public to a flooding hazard?

Analysis: *No Impact; All Alternatives.*

There is no danger of flooding due to agricultural irrigation even from an accidental release.

Alternatives 1, 4, and 5 do not have and agricultural irrigation component.

Mitigation: No mitigation is needed.

Impact: 7.7.6. Will the agricultural irrigation component cause an increase in the potential exposure of the public to disease vectors (i.e., mosquitoes)?

Analysis: *Less than Significant; Alternatives 2 and 3.*

Ponding may occur when irrigation rates exceed crop uptake, evapotranspiration, and percolation. Surface water that persists for more than four days provides potential habitat for mosquito larvae. Measure 2.2.7, Prohibit Creation of Mosquito Habitat, adopted as part of the Project, would reduce irrigation water ponding and over irrigation, thereby minimizing the potential for creation of mosquito habitat. Accidental ponding will be temporary and will not last long enough for mosquito habitat to develop.

No Impact; Alternatives 1, 4 and 5.

These alternatives do not have an agricultural irrigation component.

Mitigation: No additional mitigation is proposed.

Geysers Steamfield Component

Table 4.7-17

Public Health and Safety Impacts by Component - Geysers Steamfield

Evaluation Criteria	As Measured by	Impact	Type of Impact[1]	Level of Significance[2]
7.8.1. Will the geysers steamfield component expose the public to chemicals, radionuclides, pathogenic viruses, bacteria, or other disease organisms, at concentrations detrimental to human health?	Exceedence of State or Federal drinking water standards or human health-based criteria at a domestic water source, or DHS standards for reclaimed water.	None	O&M	==
7.8.2. Will the geysers steamfield component expose workers or the public to hazards from a known hazardous waste site?	Ground disturbance within 500 feet of a hazardous waste site(s).	Yes	C	⊙
7.8.3. Will the geysers steamfield component increase potential exposure of the public to hazardous materials due to a chemical release?	Any increase in use or storage of hazardous materials not in accordance with state and federal hazardous materials/waste regulations.	None	C, O&M	==
7.8.4. Will the geysers steamfield component expose the public to safety hazards associated with operation of heavy machinery, vehicles, or equipment; or creation of accessible excavations or creation of an accessible open body of water?	Use of heavy machinery, vehicles or equipment; creation of excavations; or creation of an open body of water in public areas not in accordance with State construction safety regulations.	None	C, O&M	==
7.8.5. Will the geysers steamfield component expose public to a flooding hazard?	Increased hazard due to construction not in accordance with state and federal regulations.	None	P	==

Table 4.7-17

Public Health and Safety Impacts by Component - Geysers Steamfield

Evaluation Criteria	As Measured by	Impact	Type of Impact[1]	Level of Significance[2]
7.8.6. Will the geysers steamfield component increase the potential exposure of the public to disease vectors (i.e., mosquitoes)?	Greater than 0 acres of new mosquito habitat.	None	O&M	==

Source: Parsons Engineering Science, Inc., 1996

Notes: 1. Type of Impact:
C Construction
O&M Operation and Maintenance
P Permanent

2. Level of Significance codes:
⊙ Significant impact before mitigation; less than significant impact after mitigation
== No impact
-- Not Applicable

Impact: **7.8.1, 3, 4, 5, 6. Will the geysers steamfield component impact public health and safety based on evaluation criteria 1, 3, 4, 5, and 6?**

Analysis: *No Impact; All Alternatives.*

Water will be injected into the geysers steamfield at a depth in excess of 3,000 feet and will not impact groundwater used as a domestic water source nor be released to the surface environment.

Construction activities for the geysers steamfield recharge will be conducted in accordance with state and federal regulations regarding materials and will not impact public safety.

Alternatives 1, 2, 3, and 5 do not have a geysers steamfield component.

Mitigation: No mitigation is needed.

Impact: **7.8.2. Will the geysers steamfield component expose workers or the public to hazards from a known hazardous waste site?**

Analysis: *Significant; Alternative 4.*

Three hazardous materials/waste sites have been identified within 500 feet of the geysers steamfield area.

No Impact; Alternatives 1, 2, 3, and 5.

These alternatives do not have a geysers steamfield component.

Mitigation: *Alternative 4.*

2.3.15 Construction Management Plan

Alternatives 1, 2, 3, and 5. No mitigation is needed.

After Mitigation: *Less than Significant after Mitigation; Alternative 4.*

Appropriate soil management will reduce impacts to less than significant.

Discharge Component

Table 4.7-18

Public Health and Safety Impacts by Component - Discharge

Evaluation Criteria	As Measured by	Impact	Type of Impact[1]	Level of Significance[2]
7.9.1. Will the discharge component expose the public to chemicals, radionuclides, pathogenic viruses, bacteria or other disease organisms, at concentrations detrimental to human health?	Exceedence of State or Federal drinking water standards or human health-based criteria at a domestic water source, or DHS standards for reclaimed water.	Risk quotient is acceptable	O&M O&M-CP	O
7.9.2. Will the discharge component expose workers or the public to hazards from a known hazardous waste site?	Ground disturbance within 500 feet of a hazardous waste site(s).	None	C	==
7.9.3. Will the discharge component increase potential exposure of the public to hazardous materials due to a chemical release?	Any increase in use or storage of hazardous materials not in accordance with state and federal hazardous materials/waste regulations.	None	C, O&M	==
7.9.4. Will the discharge component expose the public to safety hazards associated with operation of heavy machinery, vehicles, or equipment; or creation of accessible excavations or creation of an accessible open body of water?	Use of heavy machinery, vehicles or equipment; creation of excavations; or creation of an open body of water in public areas not in accordance with State construction safety regulations.	None	C, O&M	==
7.9.5. Will the discharge component expose the public to a flooding hazard?	Increased hazard due to construction not in accordance with state and federal regulations.	None	P	==

Table 4.7-18

Public Health and Safety Impacts by Component - Discharge

Evaluation Criteria	As Measured by	Impact	Type of Impact[1]	Level of Significance[2]
7.9.6. Will the discharge component increase the potential exposure of the public to disease vectors (i.e., mosquitoes)?	Greater than 0 acres of new mosquito habitat.	None	O&M	==

Source: Parsons Engineering Science, Inc., 1996

Notes:	1. Type of Impact:		2. Level of Significance codes:
C	Construction	O	Less than significant impact; no mitigation proposed
O&M	Operation and Maintenance	==	No impact
P	Permanent	--	Not Applicable

Impact: **7.9.1. Will the discharge component expose the public to chemicals, radionuclides, pathogenic viruses, bacteria, or other disease organisms, at concentrations detrimental to human health?**

Analysis: *Less than Significant; All Alternatives.*

Direct discharge of reclaimed water into the Laguna de Santa Rosa or the Russian River will not adversely affect water quality at drinking water sources and would not adversely affect human health via other potential exposure pathways. Possible human exposure pathways to reclaimed water that have been evaluated for the discharge components include movement of surface water to groundwater where it may be used as a domestic water supply, consumption of fish that have been exposed to reclaimed water, and exposure to surface water during recreational use of the river. These pathways were evaluated in a human health risk assessment for both the chemicals and microorganisms that historically have been detected in the Laguna Plant effluent (Parsons Engineering Science, Inc. 1996).

The human health risk assessment quantitatively assessed the health risk from domestic use (e.g., drinking, showering, washing) of undiluted reclaimed water and from eating fish exposed to reclaimed water. Exposure to the chemicals and microorganisms in reclaimed water via recreational contact with discharged, reclaimed water was evaluated qualitatively but not quantified. This approach was taken because the potential uptake of chemicals or microorganisms from exposure during recreational use of the Russian River or Laguna de Santa Rosa would be

much smaller than potential uptake via exposure to reclaimed water in a domestic use scenario, which includes ingestion, inhalation and dermal contact, and from eating fish. Chemicals that do not present an adverse health risk via the domestic use or fish consumption pathways will not present an adverse health risk to persons swimming or wading in the River.

Only historic concentrations of nitrate and nitrite in the Laguna Plant effluent exceed California and Federal drinking water standards and the human health criteria for the domestic use scenario (100 percent reclaimed water as a domestic water source). Discharges at a Russian River outfall, however, will be diluted with river water, which will bring the nitrate and nitrite levels below levels of concern even at the 20 percent discharge rate. In the Laguna de Santa Rosa, shallow groundwater conditions indicate that it is a groundwater discharge area, that is, during winter months (the discharge season) when groundwater levels are high, the prevailing hydrologic conditions result in movement of water from groundwater into streams (Section 4.5, Groundwater). Thus, neither discharge location will adversely affect drinking water quality at domestic water sources.

The human health risk assessment found no chemicals that presented an unacceptable risk via the fish consumption pathway. Swimming or wading will not adversely affect human health because ingestion during recreational exposure (possibly of a few milliliters on an irregular basis) would be very much less than ingestion in the domestic exposure, which assumes a person drinks 2 liters of water per day. In addition, discharge would occur during the time of year when the recreational activities that represent the highest potential level of exposure (i.e., swimming and wading) will be least likely to occur.

Microorganism concentrations (coliform bacteria) are below levels set by the State for reclaimed water usage for recreational impoundments. In addition, the concentrations of coliform bacteria in the Russian River upstream of the confluence with Mark West Creek are higher than the historical concentrations in the Laguna Plant effluent. Thus the discharge does not present any additional risk than already exists in the River, based on the presence of coliform bacteria. While *Giardia lamblia* cysts were detected in the Laguna Plant effluent, they do not present an unacceptable risk based on the EPA's risk criterion as stated in the Surface Water Treatment Rule and calculated in the human health risk assessment. In addition, *Giardia* cysts have been detected in the Russian River. No other pathogenic microorganisms (*Cryptosporidium*, *Legionella*, *Salmonella*, *Shigella*, or enteric viruses) were detected in the Laguna Plant effluent.

Mitigation: No mitigation is proposed.

Impact: **7.9.2, 3, 4, 5, and 6. Will the discharge component impact public health and safety based on evaluation criteria 2, 3, 4, 5, and 6?**

Analysis: *No Impact; All Alternatives.*

No hazardous materials/waste sites were identified within 500 feet of the Russian River outfall.

Any hazardous materials used in the construction or operation of the discharge facilities will be stored and used in accordance with state and federal regulations regarding hazardous materials.

Discharge facilities will be constructed in areas that are generally not accessible to the public. Although heavy equipment (e.g., backhoes, excavators, trucks) will be used to construct the outfall structure, general construction safety practices such as site fencing or barricades will protect the public from these hazards during construction activities. Construction activities will not impact public safety.

There will be no impacts from flooding or disease vectors because no impounded bodies of water will be created.

Mitigation: No mitigation is needed.

CUMULATIVE IMPACTS

There are four impacts -- either less than significant or significant -- identified in the Public Health and Safety section:

Impact: **7.1C. Will the Project plus cumulative projects expose the public to chemicals, radionoculides, pathogenic viruses, bacteria, or other disease organisms, at concentrations detrimental to human health?**

Analysis: Alternatives 2, 3 and 5. Standards set by the State Department of Health Services for exposure to reclaimed water are protective of farm workers and other workers who are exposed for long periods every day for a long duration exposure. Therefore, the Long-Term Project has been evaluated against standards intended for long duration exposures and cumulative impacts need not be considered.

For a discussion of increased nitrate in aquifers downgradient of reservoir sites refer to the Section 4.5, Groundwater.

Impact: **7.2C. Will the Project plus cumulative projects expose workers or the public to hazards from a known hazardous waste site?**

Analysis: Alternatives 2,3,4 and 5A. This exposure is a site-specific hazard and is not subject to cumulative impacts from other projects.

Impact: **7.3C. Will the Project plus cumulative projects increase potential exposure of the public to hazardous materials due to a chemical release?**

Analysis: Alternatives 2, 3, 4, and 5. Because Project use of chlorine will be fully in accordance with applicable laws, and these laws are protective of public safety considering all hazardous chemical use, cumulative impacts are less than significant.

Impact: **7.5C. Will the Project plus cumulative projects expose the public to a flooding hazard?**

Analysis: Alternative 2B. The potential inundation area of the Adobe Road reservoir would overlap with the potential inundation area of the proposed City of Petaluma reservoir for a small area south of Adobe Road. Because both would be built according to state and federal regulations, this would not be a significant impact. All other reservoirs will not be affected by other projects in the area.

Impact: **7.6C. Will the Project plus cumulative projects increase the potential exposure of the public to disease vectors (i.e., mosquitoes)?**

Analysis: Alternatives 2 and 3. The list of cumulative projects includes new storage reservoirs for the City of Healdsburg, the City of Petaluma, the Sonoma County Airport, and the City of Santa Rosa for Gallo properties near Cotati (an interim project). Each of these projects could provide increased mosquito habitat. The Long-Term Project impacts are identified as significant and fully mitigated. The cumulative projects listed would also be subject to the same requirements of the Marin Sonoma Mosquito Abatement District and would be fully mitigated. Cumulative impacts after mitigation are not expected.

SUMMARY OF SIGNIFICANT IMPACTS AND MITIGATION MEASURES

Table 4.7-19

Summary of Significant Impacts and Mitigation Measures - Public Health and Safety

Impact	Level of Significance	Mitigation Measure
Pipeline Component		
7.4.2. The pipeline component may be constructed on or within a known hazardous waste site.	Alt. 2 - ⊙ Alt. 3 - ⊙ Alt. 4 - ⊙ Alt. 5A - ⊙	2.3.15. Construction Management Program
Storage Reservoir Component		
7.5.1. The storage reservoir component may expose the public to chemical, radionuclides, or pathogens at concentrations detrimental to human health.	Alt. 2 - ⊙ Alt. 3 - ⊙	2.3.12. Provide replacement water supply for affected wells.
7.5.6. The storage reservoir component may increase the potential exposure of the public to disease vectors.	Alt 2 - ⊙ Alt 3 - ⊙	2.3.16. Mosquito Prevention Program
Pump Station Component		
7.6.2. The pump station component may be constructed on or within a known hazardous waste site.	Alt. 2 - ⊙ Alt. 3 - ⊙ Alt. 4 - ⊙	2.3.15. Construction Management Program
Agricultural Irrigation Component		
7.7.2. The agricultural irrigation component may expose workers or the public to hazards from a known hazardous waste site.	Alt. 2 - ⊙ Alt. 3 - ⊙	2.3.15. Construction Management Program
Geysers Steamfield Component		
7.8.2. The geysers steamfield component may expose workers or the public to hazards from a known hazardous waste site.	Alt. 4 - ⊙	2.3.15. Construction Management Program

Source: Parsons Engineering Science, Inc., 1995

Notes:
⊙ Significant impact before mitigation; less than significant impact after mitigation

SUMMARY OF IMPACTS BY ALTERNATIVE

Table 4.7-20

Summary of Impacts by Alternative - Public Health and Safety

Component	Alt 1	Alt 2A	Alt 2B	Alt 2C	Alt 2D	Alt 3A	Alt 3B	Alt 3C	Alt 3D	Alt 3E	Alt 4	Alt 5A	Alt 5B
No Action (No Project) Alternative	○	--	--	--	--	--	--	--	--	--	--	--	--
Headworks Expansion	--	○	○	○	○	○	○	○	○	○	○	○	○
Urban Irrigation	--	○	○	○	○	○	○	○	○	○	--	--	--
Pipelines	--	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	--
Storage Reservoirs	--	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	--	--	--
Pump Stations	--	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	--	--
Agricultural Irrigation	--	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	--	--	--
Geysers Steamfield	--	--	--	--	--	--	--	--	--	--	⊙	--	--
Discharge	--	○	○	○	○	○	○	○	○	○	○	○	○

Source: Parsons Engineering Science, Inc., 1996

Notes: Level of Significance Codes

-- Not applicable
== No impact
○ Less than significant impact; no mitigation proposed
⊙ Significant impact; less than significant after mitigation

PREPARERS, REFERENCES, AND CONSULTATION AND COORDINATION

Preparers

Dennis Brown, Parsons Engineering Science, Inc.

Reviewers

John Hake, Parsons Engineering Science, Inc.
Sandia Potter, Parsons Engineering Science, Inc.
Linda Stone, Parsons Engineering Science, Inc.
Dave Smith, Merritt Smith Consulting
Robin P. Cort, Ph.D, Parsons Engineering Science, Inc.
Anders J. Hauge, Harland Bartholomew & Associates, Inc.
Patricia I. Collins, Harland Bartholomew & Associates, Inc.
John Cummings, Ph.D., Peer Review Committee
David Ziegler, Peer Review Committee

References

HBA Team Documents

Dames and Moore. 1996. *Dam Break Inundation Analysis.* January. (Appendix J-1).

Merritt Smith Consulting. 1996. *Reclaimed Water Quality.* (Appendix H-2)

Questa Engineering Corporation. 1996. *Irrigation Management Guidelines for West County and South County Alternatives.* July. (Appendix D-19).

Questa Engineering Corporation. 1996. *Urban Irrigation Management Guidelines.* (Appendix D-20).

Parsons Engineering Science, Inc. 1995. *Human Health Effects and Wildlife Effects of Environmental Estrogens.* September. (Appendix J-2).

Parsons Engineering Science, Inc. 1996. *Human Health Risks from Chemical and Biological Components of Reclaimed Water.* February. (Appendix J-3).

Other References

CH2M Hill, Inc. 1993. *Final Report, Russian River Demonstration Study.* July.

City of Cotati. 1994. *City of Cotati, 1994 Water Quality Annual Report.*

City of Petaluma. 1994. *1994 City of Petaluma Annual Water Quality Report.*

City of Rohnert Park. 1994. *City of Rohnert Park 1994 Annual Water Quality Report.*

City of Santa Rosa. 1991. *Hazardous Materials Management Plan, Laguna Water Reclamation Plant.* December 11.

City of Santa Rosa Utilities Department. 1994. *City of Santa Rosa, Water Quality Annual Report.*

City of Sebastopol Public Works Department. 1994. *Annual Water Quality Report for the Year Ended December 31, 1994.*

Environmental Rick Information & Imaging Services. 1995. *Environmental Database Search Summary Report.*

Jansen, R.B. 1988. *Dam Safety in America,* Hydro Review, pp. 10-20. June.

Madhaven, S., K.D. Rosenman, and T. Shehata 1989. *Lead in Soil: Recommended Maximum Permissible Levels,* Environmental Research 49: 136-142.

Sonoma County Water Agency. 1994. *Sonoma County Water Agency 1994 Water Quality Report.*

USEPA. 1994. *Drinking Water Standard Setting, Question and Answer Primer, EPA 811-K-94-001.* November.

Consultation and Coordination

Persons Contacted

Head, James, Engineer, Department of Water Resources, Division of Safety of Dams, personal communication, February 2, 1996.

Hulquist, Bob, Department of Health Services, personal communication, February 2, 1996.

Correspondence

None.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

4.8 TERRESTRIAL BIOLOGICAL RESOURCES

This section describes special-status species, vegetation communities, and wildlife habitats within the Project area and addresses potential Project-specific and cumulative impacts to these resources. Impacts evaluated include the potential for loss of special status (endangered, threatened rare or protected) species associated with terrestrial habitats, potential for loss of sensitive vegetation communities and wildlife habitats, blockage of major migration corridors, potential detrimental effects to nesting raptors and ecological risk to terrestrial wildlife resources from toxicity or bioaccumulation. The section also identifies mitigation measures that, upon implementation, will reduce the magnitude of significant impacts.

IMPACTS EVALUATED IN OTHER SECTIONS

The following items are related to the Terrestrial Biological Resources but are evaluated in other sections of this document.

- Impacts to Aquatic Biological Resources. Aquatic plant and wildlife species are those species which spend all or an important part of their life cycle within an aquatic system. Some aquatic species also spend part of their life cycle in terrestrial systems. Impacts associated with these species and their habitats are discussed in Section 4.9, Aquatic Biological Resources.
- Impacts to Wetlands. Impacts caused by the discharge of dredge and fill material into jurisdictional wetlands, or the inundation of wetlands at storage reservoir sites with reclaimed water, are discussed in Section 4.10, Jurisdictional Wetlands Resources.

AFFECTED ENVIRONMENT (SETTING)

The affected environment for the alternatives includes the biological resources within the Area of Indirect Impacts (Figure 4.8-1a, 1b, 1c) and Area of Direct Impacts. The Area of Indirect Impacts encompasses the watersheds potentially affected by Project components such as storage reservoirs, discharge, and agricultural irrigation areas. Watersheds located within the Area of Indirect Impacts include the areas drained by the Laguna de Santa Rosa, Russian River, Petaluma River, Tolay Creek, Stemple Creek, and Americano Creek. The Area of Direct Impacts only includes the construction boundary zones of the Project components.

The affected environment of the Area of Indirect Impacts and Area of Direct Impacts includes various terrestrial biological resources which are described in terms of plant

communities (including sensitive natural communities), wildlife habitats, and special-status plant and animal species.

The terrestrial biological resources within the Area of Indirect Impacts are also included in several natural resource planning efforts. The goals and objectives of these planning efforts are considered as part of the affected environment in the following discussion. The terrestrial biological communities and natural resource planning efforts within the Area of Indirect Impacts are described below on a regional and local scale.

Regional Terrestrial Biological Resources

A variety of factors including historical and current development have reduced the abundance and diversity of the terrestrial resources associated with the major terrestrial ecosystems in the region, leading to the protection or the proposed protection of several species (i.e., special-status species). Lists of special-status species potentially occurring in the region were provided by the California Department of Fish and Game, the National Marine Fisheries Service, and the U.S. Fish and Wildlife Service. Additional information regarding special-status species was obtained from the California Native Plant Society and Madrone Audubon Society. The comprehensive special-status plant and wildlife lists generated by this process include 182 plant species and 102 wildlife species. The lists were consolidated and are included in *Biological Resources, Volume 2* (Harland Bartholomew & Associates 1996b). Professional judgment of the Project biologists and coordination with resource experts resulted in a reduced number of special-status species, those deemed most likely to occur within the Area of Indirect Impacts. An explanation of the screening process is provided in the *Biological Resources*, *Volume 2 (*Harland Bartholomew & Associates 1996b).

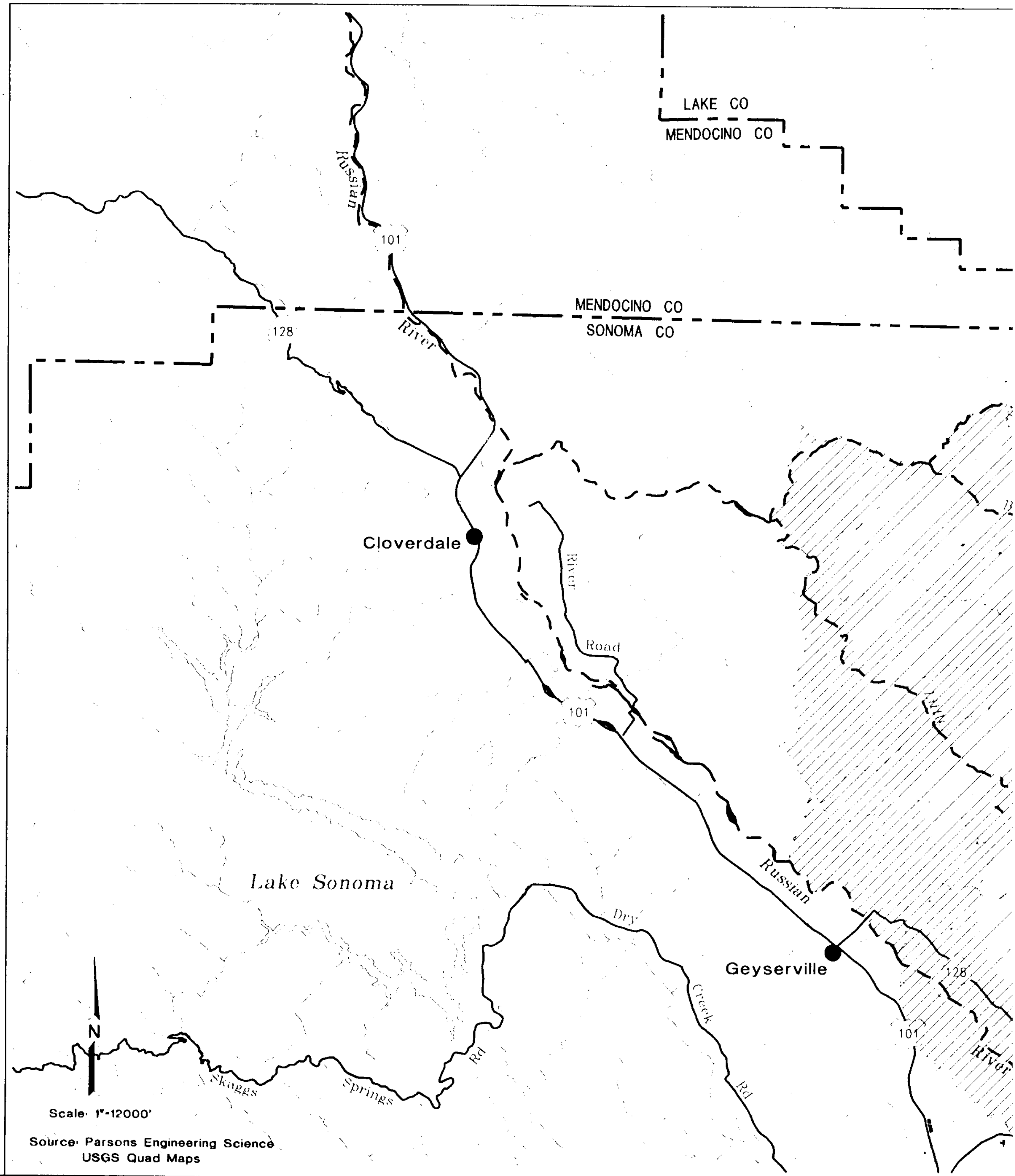
Approximately 131 special-status terrestrial plant and wildlife species have been identified as potentially occurring in the Area of Indirect Impacts and consequently are evaluated in this EIR/EIS (Tables 4.8-1 and 4.8-2). Special-status species include:

- those plants and animals that are legally protected, proposed, or candidates for protection under the California Endangered Species Act (CESA) and Federal Endangered Species Act (FESA);

- plants and animals defined as endangered or rare under the California Environmental Quality Act (CEQA);

- animals designated as species of special concern by the California Department of Fish and Game;

(1)

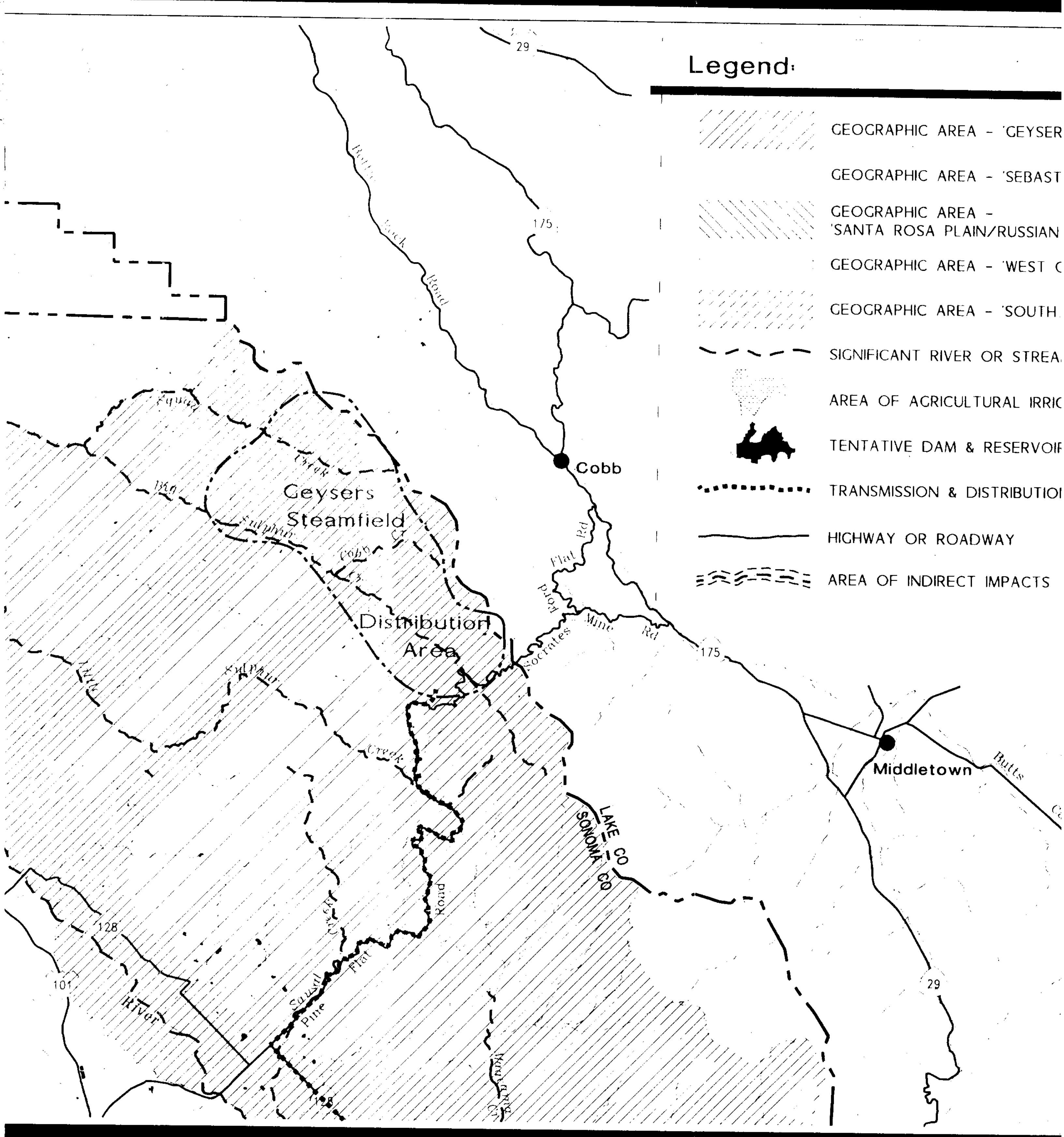


HARLAND BARTHOLOMEW and ASSOCIATES, INC.

A UNIT OF PARSONS INFRASTRUCTURE and TECHNOLOGY GROUP INC

PARSONS

Santa Ros



anta Rosa

Subregional Long-Term
Wastewater Project

Figu

GEOGRAPHIC AREAS
AND AREA OF INDIRECT I

5

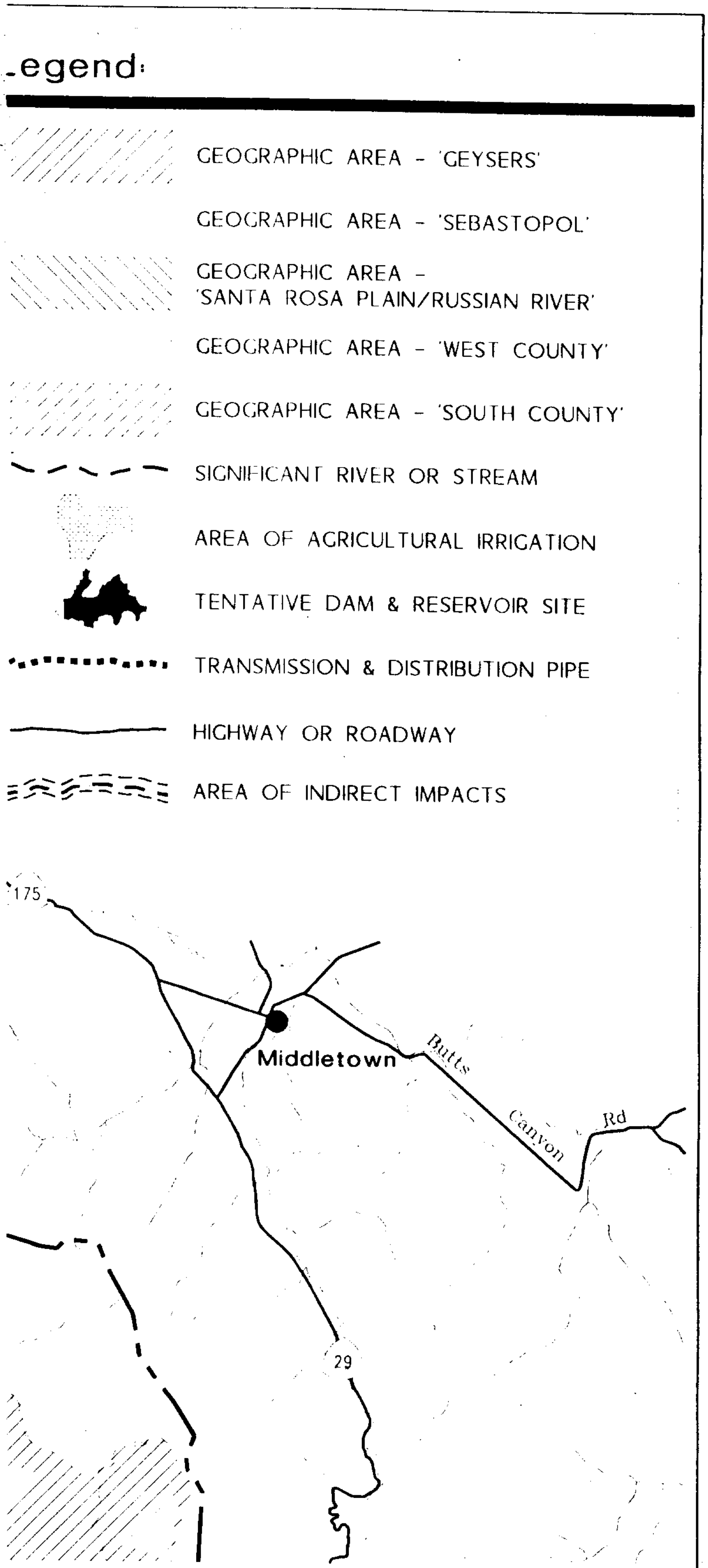
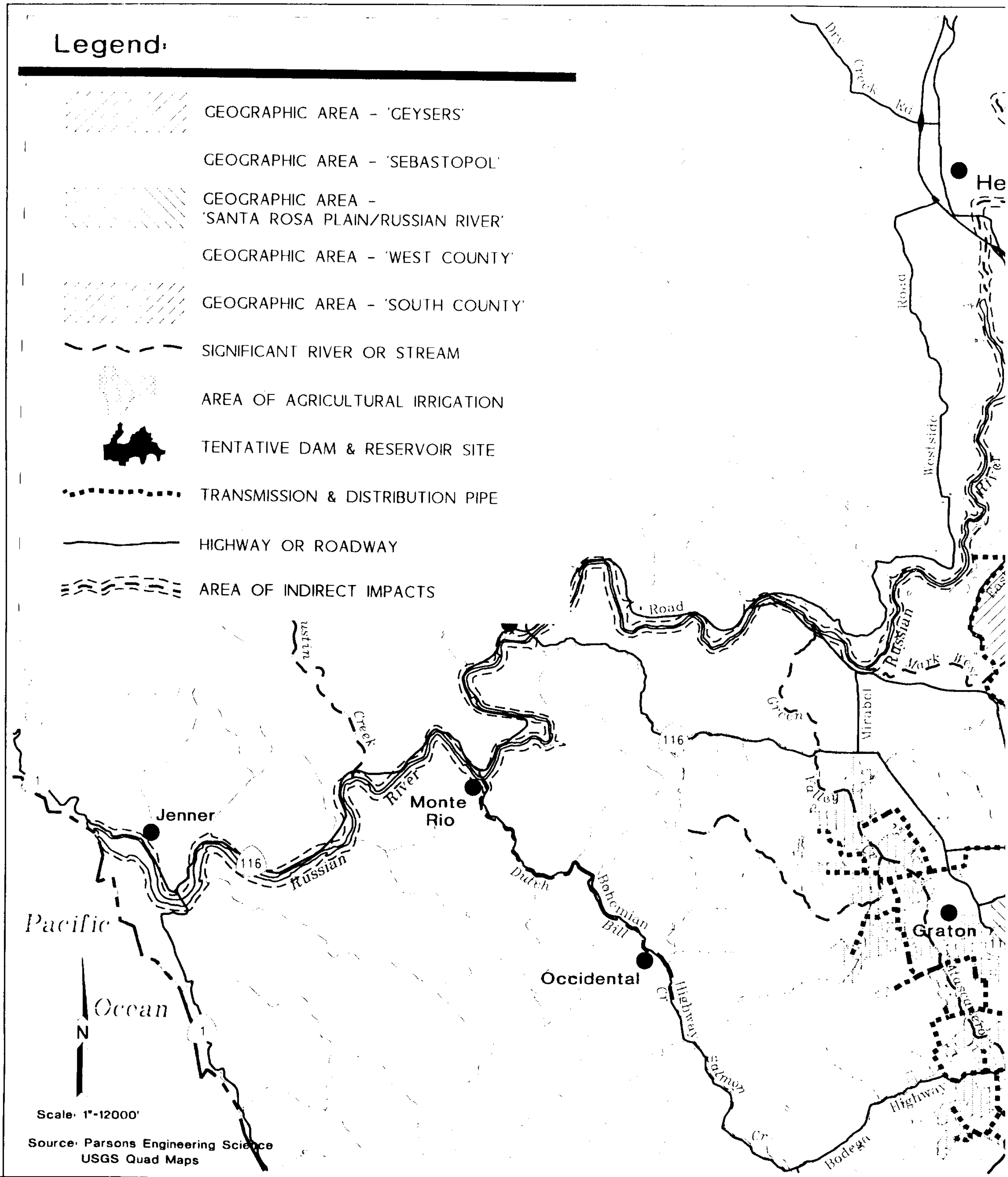


Figure 4.8-1a

GEOGRAPHIC AREAS AND AREA OF INDIRECT IMPACTS

(1)



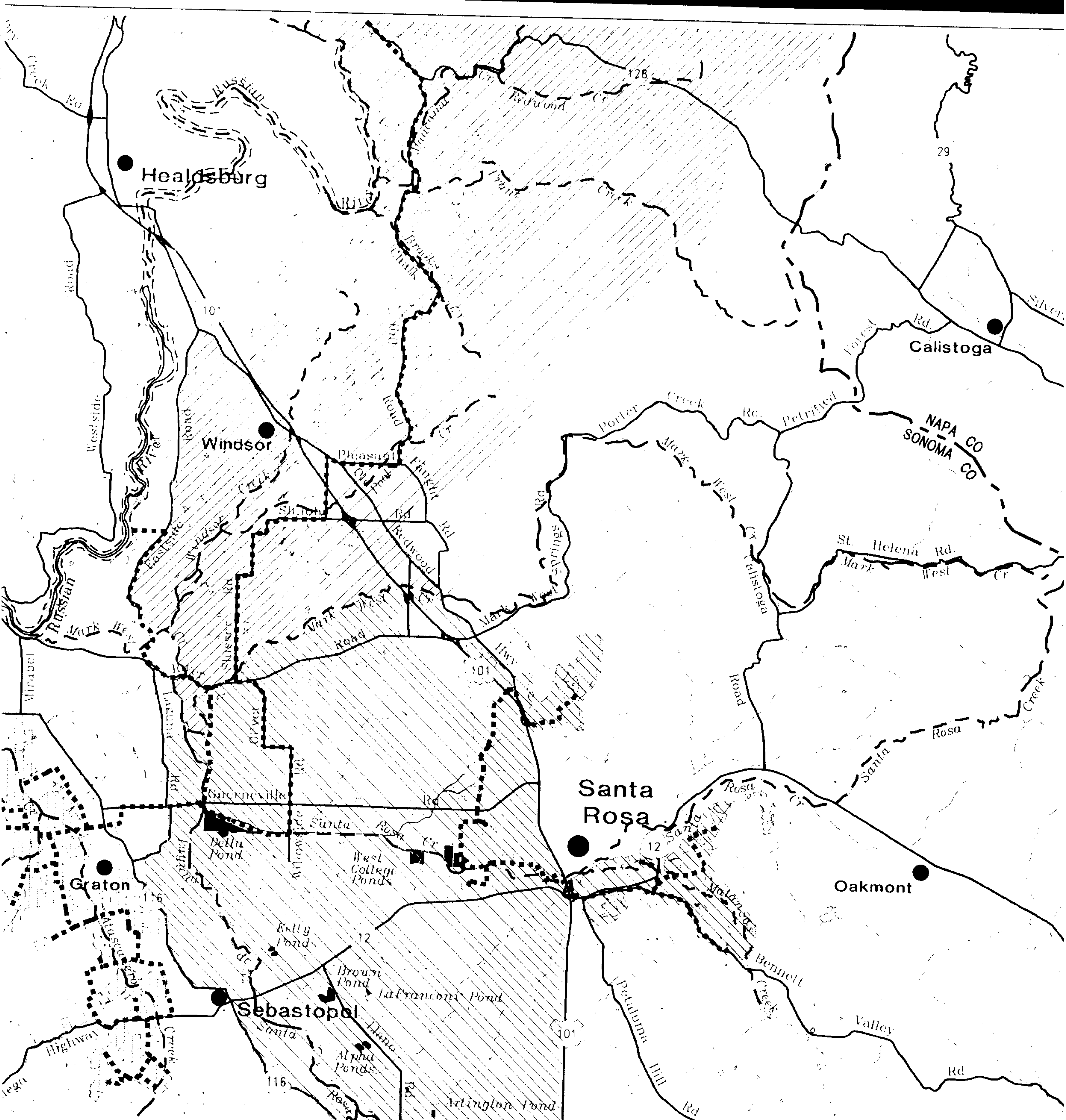
HARLAND BARTHOLOMEW and ASSOCIATES, INC.

A UNIT OF PARSONS INFRASTRUCTURE and TECHNOLOGY GROUP INC.

PARSONS

Santa Ro

2



anta Rosa

Subregional Long-Term
Wastewater Project

GEOGRAPHIC AREAS
AND AREA OF INDIRECT I

Figu

(3)

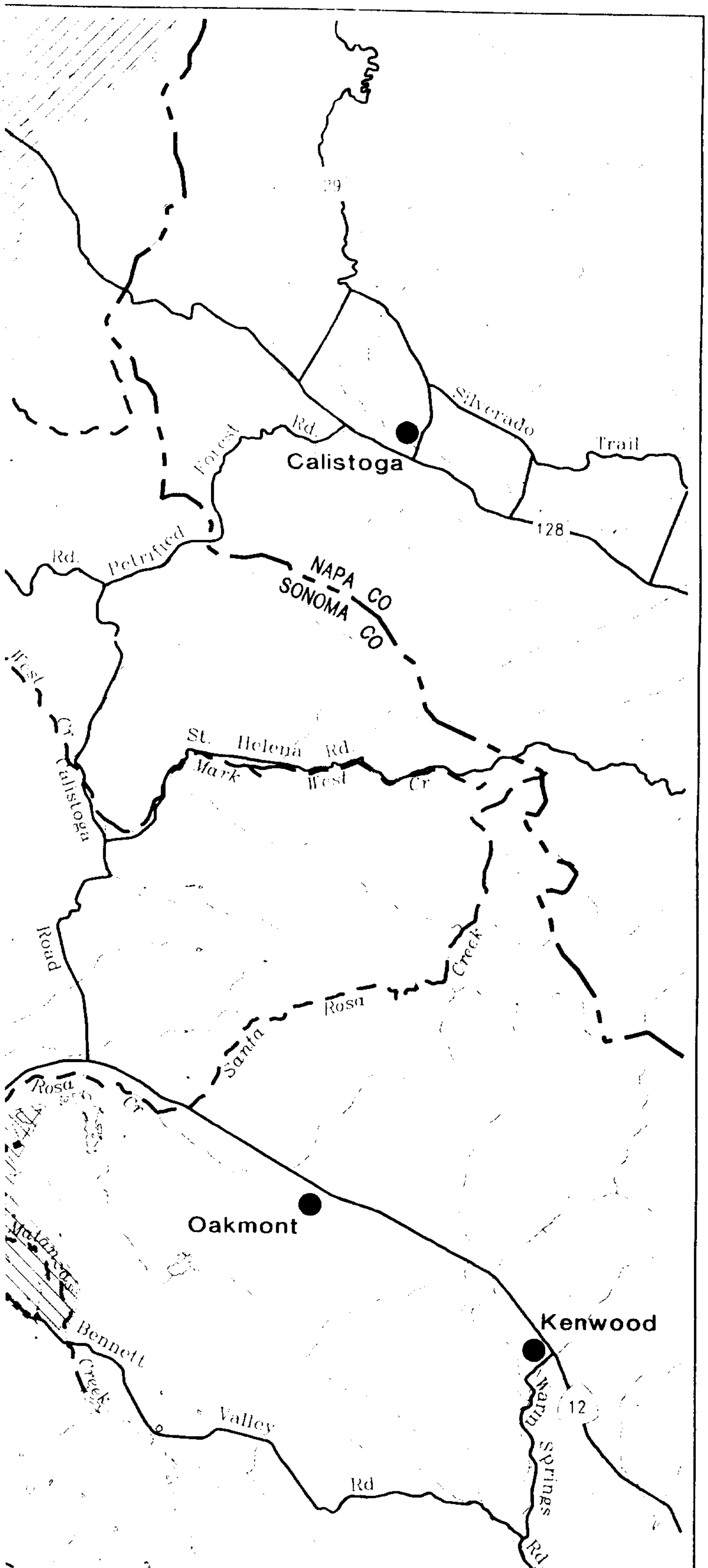
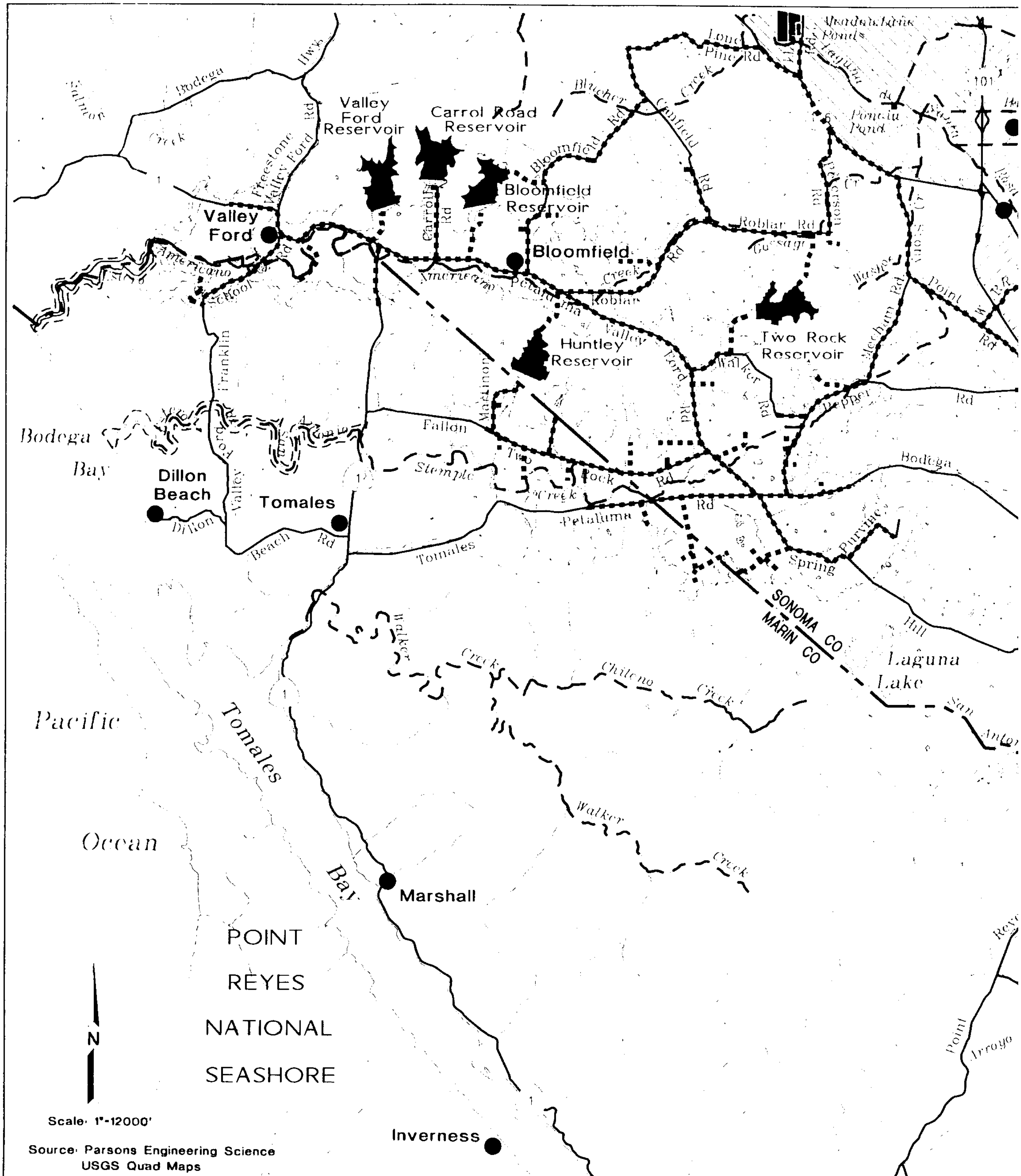


Figure 4.8-1b

GEOGRAPHIC AREAS AND AREA OF INDIRECT IMPACTS

(1)



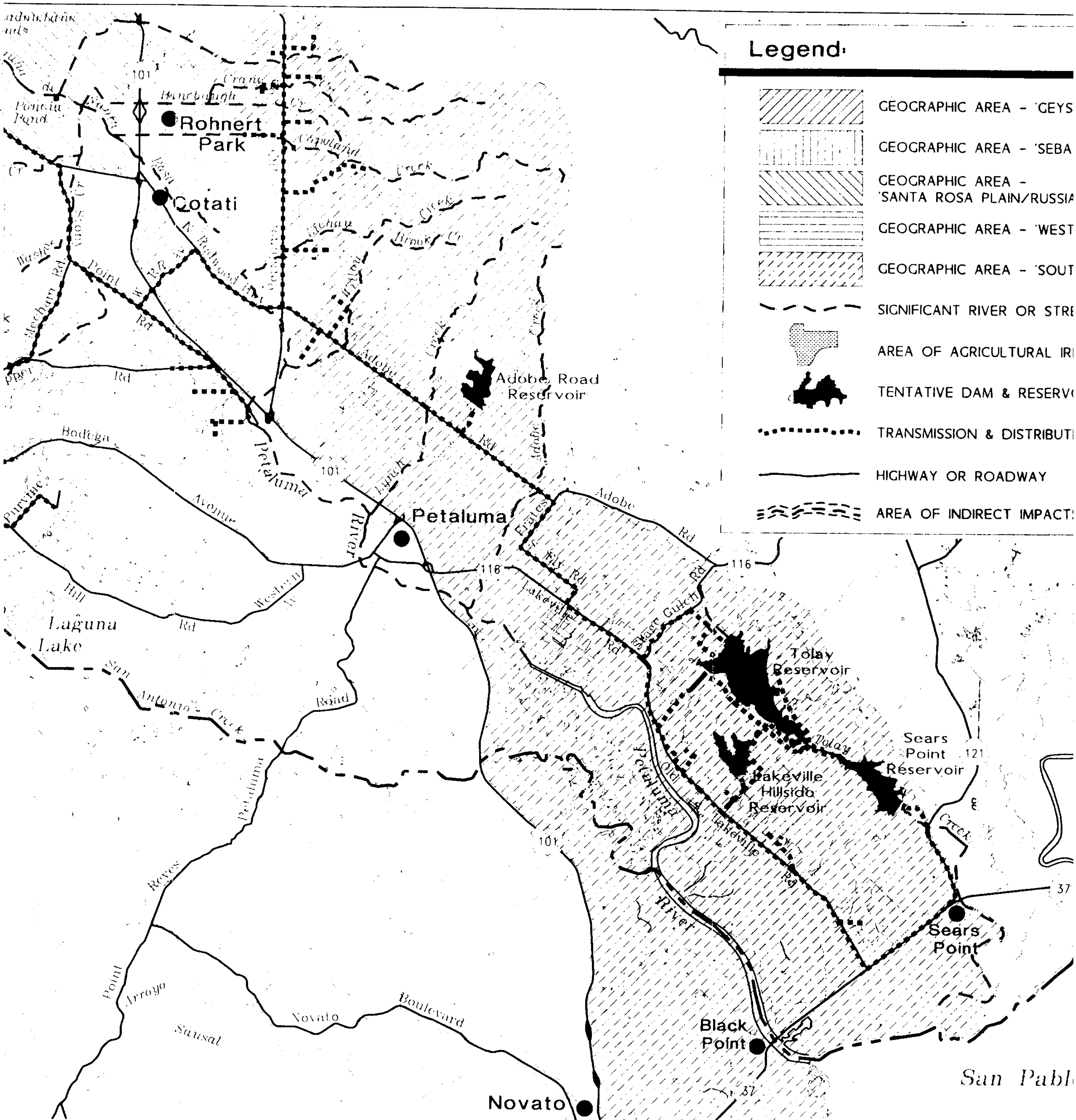
HARLAND BARTHOLOMEW and ASSOCIATES, INC.

A UNIT OF PARSONS INFRASTRUCTURE and TECHNOLOGY GROUP INC

PARSONS

Santa Ro

(2)



Santa Rosa

Subregional Long-Term
Wastewater Project

Fig

GEOGRAPHIC AREAS
AND AREA OF INDIRECT I

(3)

Legend

- GEOGRAPHIC AREA - 'GEYSERS'
- GEOGRAPHIC AREA - 'SEBASTOPOL'
- GEOGRAPHIC AREA - 'SANTA ROSA PLAIN/RUSSIAN RIVER'
- GEOGRAPHIC AREA - 'WEST COUNTY'
- GEOGRAPHIC AREA - 'SOUTH COUNTY'
- SIGNIFICANT RIVER OR STREAM
- AREA OF AGRICULTURAL IRRIGATION
- TENTATIVE DAM & RESERVOIR SITE
- TRANSMISSION & DISTRIBUTION PIPE
- HIGHWAY OR ROADWAY
- AREA OF INDIRECT IMPACTS

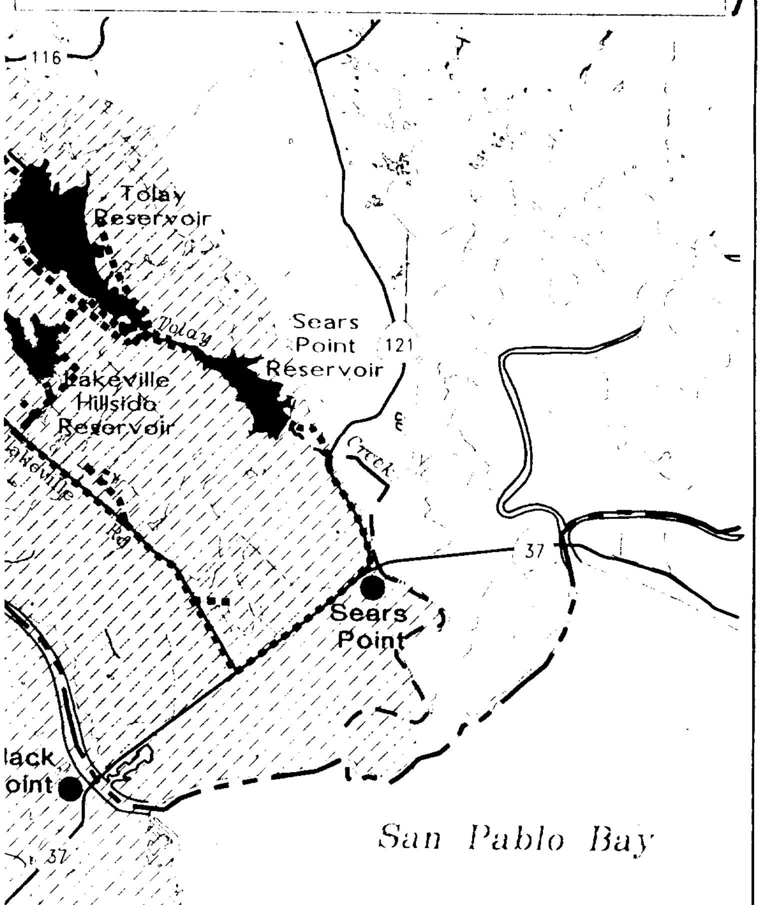


Figure 4.8-1c

GEOGRAPHIC AREAS AND AREA OF INDIRECT IMPACTS

Table 4.8-1

Special-Status Plant Species

PLANTS	STATUS				MANAGEMENT CONCERNS	
Species	**State**	**Federal**	**CNPS**	**Source**	**Habitat**	**Potential Threats**
Abronia umbellata ssp. *breviflora* Pink sand-verbena	--	--	1B	8	Coastal dunes	Vehicles and foot traffic.
Agrostis blasdalei var. *blasdalei* Blasdale's bent grass	--	--	1B	3,8	Coastal dunes, coastal bluff scrub, and coastal prairie, gravelly soils.	Agriculture and recreation.
Agrostis blasdalei var. *marinensis* Marin bent grass	SR	--	--	1	Coastal dunes and coastal prairie	Agriculture and recreation.
Amsinckia lunaris Bent-flowered fiddleneck	--	--	4	6,8	Open woods, grassland, and mixed chaparral.	Limited distribution.
Antirrhinum virga Tall snapdragon	--	--	4	6,8	Openings in chaparral, rocky areas, often on serpentine.	Limited distribution.
Arabis blepharophylla Coast rock cress	--	--	4	6,8	Rocky soils, outcrops; chaparral; broadleaved, upland forests; coastal prairie; and coastal scrub.	Limited distribution.
Arctostaphylos bakeri ssp. *bakeri* Baker's manzanita	SR	--	1B	1,3,8	Broadleaved, upland forests; and chaparral, often ultramafic [i.e., highly acidic soils]; and serpentine outcrops.	Road construction, non-native plants, dumping, and development.

Notes and sources are at the end of the table.

Table 4.8-1

Special-Status Plant Species

PLANTS	STATUS				MANAGEMENT CONCERNS	
Species	State	Federal	CNPS	Source	Habitat	Potential Threats
Arctostaphylos bakeri ssp. *sublaevis* The Cedars manzanita	--	--	1B	8	Serpentine outcrops, ridges, and chaparral.	Rare throughout its range.
Arctostaphylos canescens ssp. *sonomensis* Sonoma manzanita	--	--	1B	6,8	Ridges, slopes, chaparral, and forest.	Development.
Arctostaphylos densiflora Vine Hill manzanita	SE	--	1B	1,3,8	Found in association with chaparral (acid marine sand), and shale outcrops.	Fungal infection.
Arctostaphylos hispidula Howell's manzanita	--	--	4	3,8	Rocky, serpentine soils or sandstone; open sites; and forest.	Mining.
Arctostaphylos stanfordiana ssp. *decumbens* Rincon manzanita	--	--	1B	3	Found in association with chaparral, open areas.	Development, road construction, vehicles, and viticulture.
Arctostaphylos stanfordiana ssp. *raichei* Hopland manzanita	--	--	1B	8	Chaparral (often associated with serpentinite).	Urbanization.
Arctostaphylos virgata Marin manzanita	--	--	1B	8	Broadleaved, upland forests; closed-cone coniferous forests; north coast forests; chaparral; sandstone; and granitic outcrops.	Fire suppression.

Notes and sources are at the end of the table.

Table 4.8-1

Special-Status Plant Species

PLANTS	STATUS				MANAGEMENT CONCERNS	
Species	**State**	**Federal**	**CNPS**	**Source**	**Habitat**	**Potential Threats**
Asclepias solanoana Serpentine milkweed	--	--	4	8	Cismontane woodland, conifer forest, serpentine outcrops, and chaparral.	Grazing, vehicles, logging, mining, and geothermal development.
Astragalus breweri Brewer's milk-vetch	--	--	4	6,8	Cismontane woodland, open slopes, and grassy areas, sometimes on serpentine.	Development and road construction
Astragalus clarianus Clara Hunt's milk-vetch	ST	FPE	1B	2,3,5,8, 10	Cismontane woodland, valley-foothill grassland, and open grassy areas on thin soil.	Recreational development and non-native plants.
Astragalus rattanii var. *rattanii* Rattan's milk-vetch	--	--	4	8	Cismontane woodland, conifer forest, river banks, sandbars, and gravelly streambanks.	Limited distribution.
Blennosperma nanum var. *robustum* Point Reyes blennosperma	SR	--	1B	1,8,5	Coastal prairie, coastal scrub, grassy places in shrubs, and sandy soils.	Grazing.
Calamagrostis ophitidis Serpentine reed grass	--	--	4	8	Chaparral, meadows, and valley-foothill grassland on serpentine.	Limited distribution.
Calandrinia breweri Brewer's calandrinia	--	--	4	8	Sandy to loamy soils, disturbed places, burns, chaparral, and coastal scrub.	Limited distribution.

Notes and sources are at the end of the table.

Table 4.8-1

Special-Status Plant Species

PLANTS	STATUS				MANAGEMENT CONCERNS	
Species	**State**	**Federal**	**CNPS**	**Source**	**Habitat**	**Potential Threats**
Calochortus raichei The Cedars fairy-lantern	--	--	1B	8	Closed-cone coniferous forests, ultramafic chaparral, and open serpentine in woodlands.	Mining and road construction
Calyptridium quadripetalum Four-petaled pussypaws	--	--	4	6,8	Chaparral, and sandy or gravelly areas, generally on serpentine.	Limited distribution.
Calystegia collina ssp. *oxyphylla* Mount Saint Helena morning-glory	--	--	4	3,8	Chaparral and serpentine chaparral; open, grassy or rock; open oak/pine woods; serpentine.	Limited distribution.
Cardamine pachystigma var. *dissectifolia* Dissected-leaf toothwort	--	--	3	8	Chaparral and serpentine outcrops.	Lack of information and taxonomic uncertainty.
Castilleja affinis ssp. *neglecta [C. neglecta]* Tiburon Indian paintbrush	ST	FE	1B	1,2,5,8	Associated with valley-foothill grasslands on serpentine soils and open serpentine slopes.	Development, gravel mining, and grazing.
Ceanothus confusus Rincon Ridge ceanothus	--	--	1B	3,8	Serpentine and volcanic chaparral, closed-cone coniferous forest, and cismontane woodland on dry, shrubby slopes.	Development.
Ceanothus divergens Calistoga ceanothus	--	--	1B	3,8	Found in association with serpentine chaparral; and dry, rocky, volcanic slopes.	Development in the geysers geothermal area.

Notes and sources are at the end of the table.

Table 4.8-1

Special-Status Plant Species

PLANTS	STATUS				MANAGEMENT CONCERNS	
Species	State	Federal	CNPS	Source	Habitat	Potential Threats
Ceanothus foliosus var. *vineatus* Vine Hill ceanothus	--	--	1B	5,8	Chaparral and dry, rolling hills.	Rare throughout its range.
Ceanothus gloriosus var. *gloriosus* Point Reyes ceanothus	--	--	4	6,8	Coastal bluff scrub, closed-cone forest, coastal dunes, and coastal scrub/sandy.	Limited distribution.
Ceanothus masonii Mason's ceanothus	SR	--	1B	1,3,8	Chaparral and dry, rocky slopes on Bolinas Ridge.	Rare throughout its range.
Ceanothus sonomensis Sonoma ceanothus	--	--	1B	3,8	Chaparral, sandy soils, serpentine, volcanic soils; Hood Mountain Range.	Development.
Chlorogalum pomeridianum var. *minus* Dwarf soaproot	--	--	1B	8	Serpentine outcrops in chaparral.	Rare throughout its range.
Chorizanthe cuspidata var. *cuspidata* San Francisco Bay spineflower	--	--	1B	8	Sandy places, coastal dunes, coastal prairie, and coastal scrub; Merced Lake.	Rare throughout its range.
Chorizanthe cuspidata var. *villosa* Woolly-headed spineflower	--	--	1B	8	Sandy places, coastal dunes, coastal prairie, and coastal scrub.	Rare throughout its range.
Chorizanthe valida Sonoma spineflower	SE	FE	1B	1,2,3,5,8	Coastal prairie (sandy).	Rare throughout its range.

Notes and sources are at the end of the table.

Table 4.8-1

Special-Status Plant Species

PLANTS	STATUS				MANAGEMENT CONCERNS	
Species	**State**	**Federal**	**CNPS**	**Source**	**Habitat**	**Potential Threats**
Cirsium andrewsii Franciscan thistle	--	--	4	6,8	Broadleaved, upland forest; bluffs; ravines, and seeps.	Limited distribution.
Cirsium hydrophilum var. *vaseyi* Mount Tamalpais thistle	--	--	1B	8	Chaparral and broadleaved upland forests on serpentine soil, and serpentine seeps.	Road construction and non-native plant invasions.
Clarkia concinna ssp. *raichei* Raichei's red ribbons; Tomales clarkia	--	--	1B	8	Exposed sites. Known from only one occurrence near Tomales in Marin County.	Limited distribution.
Clarkia imbricata Vine Hill clarkia	SE	FPE	1B	1,2,3,5,8, 10	Meadows, valley-foothill grasslands, chaparral, clearings, and roadsides.	Development and road maintenance
Collinsia corymbosa Round-headed Chinese houses	--	--	1B	8	Coastal dunes.	Rare throughout its range.
Cordylanthus tenuis ssp. *brunneus* Serpentine bird's-beak	--	--	4	8	Closed-cone forest, chaparral, and cismontane woodland/serpentinite.	Limited distribution.
Cordylanthus tenuis ssp. *capillaris* Pennell's bird's-beak	SR	FE	1B	1,2,3,5,8	Closed-cone coniferous forests, ultramafic chaparral, and serpentine chaparral.	Dumping, vehicles, road maintenance, and development.
Cupressus goveniana ssp. *pigmaea* Pygmy cypress	--	--	1B	8	Closed-cone pine/cypress forests and coastal terrace.	Development and vehicles.

Notes and sources are at the end of the table.

Table 4.8-1

Special-Status Plant Species

PLANTS	STATUS				MANAGEMENT CONCERNS	
Species	State	Federal	CNPS	Source	Habitat	Potential Threats
Cypripedium californicum California lady's-slipper	--	--	4	6,8	Serpentine seeps and streambanks, and mixed or coniferous forest.	Horticultural collecting and logging.
Cypripedium montanum Mountain lady's-slipper	--	--	4	6,8	Moist areas, dry slopes, and mixed or coniferous forest.	Logging.
Delphinium bakeri Baker's larkspur	SR	FC	1B	1,2,3,5,8	Coastal scrub. One population known from Salmon Creek Canyon.	Agriculture, grazing, and road maintenance.
Delphinium luteum Yellow larkspur	SR	FC	1B	1,2,3,5,8	Coastal scrub, moist sites, cliffs, coastal prairie, chaparral, and rock outcrops.	Development and grazing.
Dichondra occidentalis Western dichondra	--	--	4	6,8	Cismontane woodland, slopes, chaparral, coastal scrub, and headlands under shrubs.	Limited distribution.
Dirca occidentalis Western leatherwood	--	--	1B	6,8	Moist, rocky slopes in partial shade; chaparral; broadleaved, upland forest; and riparian woodland.	Rare throughout its range.
Elymus californicus California bottle-brush grass	--	--	4	6,8	North Coast coniferous forest.	Limited distribution.

Notes and sources are at the end of the table.

Table 4.8-1

Special-Status Plant Species

PLANTS	STATUS				MANAGEMENT CONCERNS	
Species	State	Federal	CNPS	Source	Habitat	Potential Threats
Erigeron angustatus Narrow-leafed daisy	--	--	1B	8	Serpentine chaparral.	Rare throughout its range.
Erigeron biolettii Streamside daisy	--	--	3	8	North Coast forest, broadleaved upland forest, slopes, rocks, and ledges along rivers.	Lack of information and taxonomic uncertainty.
Erigeron serpentinus Serpentine daisy	--	--	1B	8	Serpentine chaparral.	Rare throughout its range.
Erigeron supplex Supple daisy	--	--	1B	6,8	Coastal prairie and bluffs.	Coastal development.
Eriogonum luteolum var. *caninum* Tiburon buckwheat	--	--	3	8	Chaparral, coastal prairie, valley-foothill grasslands, and open serpentine.	Development and non-native plants.
Eriogonum nervulosum Snow Mountain buckwheat	--	--	1B	3,8	Found in association with serpentine chaparral, and serpentine outcrops.	Rare throughout its range.
Eriogonum ternatum Ternate buckwheat	--	--	4	8	Lower montane conifer forest and serpentine outcrops.	Limited distribution.

Notes and sources are at the end of the table.

Table 4.8-1

Special-Status Plant Species

PLANTS	STATUS				MANAGEMENT CONCERNS	
Species	State	Federal	CNPS	Source	Habitat	Potential Threats
Erysimum franciscanum San Francisco wallflower	--	--	4	8	Coastal scrub and coastal dune, serpentine outcrops, and valley-foothill grassland.	Limited distribution.
Erythronium helenae Saint Helena fawn lily	--	--	4	8	Chaparral, cismontane woodland, valley-foothill grassland, and dry woodlands on serpentine.	Horticultural collecting, road construction, and geothermal development.
Fritillaria liliacea Fragrant fritillary	--	--	1B	3,8	Coastal scrub, coastal prairie, and valley-foothill grasslands.	Grazing, agricultural and urban development.
Grindelia hirsutula var. *maritima* *[G. maritima]* San Francisco gumplant	--	--	1B	8	Coastal bluff scrub, coastal scrub, and valley-foothill grassland/sandy; and serpentinite.	Coastal development and non-native plants.
Helianthella castanea Diablo helianthella	--	--	1B	3,8	Broadleaved upland forest and chaparral; valley-foothill grassland; and open grassy areas.	Urbanization, grazing, and fire suppression.
Hemizonia congesta ssp. *leucocephala* Hayfield tarplant	--	--	3	6,8	Coastal scrub and valley-foothill grassland; serpentine.	Agriculture, urban development.
Hesperevax sparsiflora var. *brevifolia* Short-leafed evax	--	--	4	8	Sandy bluffs and flats, and coastal dunes.	Limited distribution.

Notes and sources are at the end of the table.

Table 4.8-1

Special-Status Plant Species

PLANTS	STATUS				MANAGEMENT CONCERNS	
Species	State	Federal	CNPS	Source	Habitat	Potential Threats
Hesperolinon bicarpellatum Two-carpellate western flax	--	--	1B	8	Serpentine chaparral.	Development and grazing.
Hesperolinon congestum Marin western flax	ST	FT	1B	1,2,3,5,8	Chaparral and valley-foothill grasslands in association with serpentine soils.	Development and foot traffic.
Holocarpha macradenia Santa Cruz tarplant	SE	FC	1B	1,2,5,8	Valley-foothill grasslands and coastal prairie (often clay).	Urbanization, agriculture, and non-native plants.
Horkelia cuneata ssp. *sericea* Kellogg's horkelia	--	--	1B	8	Closed-cone forest and coastal scrub.	Coastal development.
Horkelia marinensis Point Reyes horkelia	--	--	1B	3,6,8	Sandy coastal flats, coastal dunes, coastal prairie, and coastal scrub.	Rare throughout its range.
Horkelia tenuiloba Thin-lobed horkelia	--	--	1B	6,8	Sandy soils in open chaparral.	Rare throughout its range.
Layia carnosa Beach layia	SE	FE	1B	1,2,5,8	Coastal dunes.	Coastal development, off-vehicles, and non-native plants.
Layia septentrionalis Colusa layia	--	--	1B	3,8	Serpentine or sandy soils in chaparral, cismontane woodlands, and valley-foothill grasslands.	Development.

Notes and sources are at the end of the table.

Table 4.8-1

Special-Status Plant Species

PLANTS	STATUS				MANAGEMENT CONCERNS	
Species	State	Federal	CNPS	Source	Habitat	Potential Threats
Lessingia arachnoidea Crystal Springs lessingia	--	--	1B	8	Cismontane woodlands, coastal scrub, and valley-foothill grasslands.	Rare throughout its range.
Lessingia hololeuca Woolly-headed lessingia	--	--	3	8	Coastal scrub, lower montane coniferous forest, and valley-foothill grasslands, clay, serpentinite, fields, and roadside ditches.	Grazing.
Lessingia micradenia var. *micradenia* Tamalpais lessingia	--	--	1B	8	Chaparral; thin, gravelly soils of serpentine outcrops; and roadcuts.	Rare throughout its range.
Lilium rubescens Redwood lily	--	--	4	6,8	Chaparral, lower montane coniferous forest, and sometimes serpentinite.	Urbanization, horticultural collection, and grazing.
Linanthus acicularis Bristly linanthus	--	--	4	8	Grassy areas in woodlands, coastal prairie, and chaparral.	Limited distribution.
Linanthus grandiflorus Large-flower linanthus	--	--	4	8	Coastal bluff and scrub, coastal prairie, valley-foothill grassland, open grassy flats, and cismontane woodland; generally in sandy soil.	Development.
Lomatium repostum Napa lomatium	--	--	4	6,8	Pine/oak woodland and chaparral, often on serpentine.	Limited distribution.

Notes and sources are at the end of the table.

Table 4.8-1

Special-Status Plant Species

PLANTS	STATUS				MANAGEMENT CONCERNS	
Species	State	Federal	CNPS	Source	Habitat	Potential Threats
Lupinus eximius (L. arboreus var. *eximius)* San Mateo tree lupine	--	--	3	8	Chaparral and coastal scrub.	Lack of information, taxonomic uncertainty.
Lupinus sericatus Cobb mountain lupine	--	--	1B	6,8	Chaparral, cismontane woodland, montane coniferous forest, and open wooded slopes.	Geothermal development, logging, and road widening.
Lupinus tidestromii Tidestrom's lupine	SE	FE	1B	1,2,8	Coastal dunes.	Coastal development, trampling, and non-native plants.
Lupinus tidestromii var. *layneae* Point Reyes clover lupine	SE	FE	1B	1,2,5,8	Coastal dunes.	Coastal development, trampling, and non-native plants.
Madia nutans Nodding madia	--	--	4	6,8	Rocky soils, cismontane woodland, and chaparral.	Limited distribution.
Micropus amphibolus Mount Diablo cottonweed	--	--	4	6,8	Broadleaved, upland forest; cismontane woodland; valley-foothill grasslands; and bare, grassy or rocky slopes.	Limited distribution.
Monardella undulata Curly-leafed monardella	--	--	4	8	Chaparral, coastal dunes, coastal scrub, and lower montane coniferous forest.	Coastal development, sand mining, and non-native plants.

Notes and sources are at the end of the table.

Table 4.8-1

Special-Status Plant Species

PLANTS	STATUS				MANAGEMENT CONCERNS	
Species	**State**	**Federal**	**CNPS**	**Source**	**Habitat**	**Potential Threats**
Monardella villosa ssp. *globosa* Robust monardella	--	--	1B	8	Openings in oak woodland and chaparral.	Rare throughout its range.
Monardella viridus ssp. *viridus* Green monardella	--	--	4	6,8	Rocky soils, open woodland, chaparral, and serpentine.	Limited distribution.
Orobanche valida ssp. *howellii* Howell's broomrape	--	--	4	6,8	Chaparral, volcanic, and serpentine slopes. Generally parasitic on *Garrya* sp.	Limited distribution.
Parvisedum leiocarpum Lake County stonecrop	SE	--	1B	1,3,8	Valley-foothill grasslands, dry vernal pools, cismontane woodlands, and rocky depressions.	Trampling, grazing, and development.
Penstemon newberryi var. *sonomensis* Sonoma beardtongue	--	--	1B	6,8	Chaparral, outcrops, and talus.	Rare throughout its range.
Pentachaeta bellidiflora White-rayed pentachaeta	SE	PE	1B	1,2,7,8	Valley-foothill grasslands with serpentine soils; rocky areas.	Historical occurrences lost to development.
Perideridia gairdneri ssp. *gairdneri* Gairdner's yampah	--	--	4	8	Moist soil of flats, meadows, streamsides, grasslands, and pine groves.	Agriculture and urban development.

Notes and sources are at the end of the table.

Table 4.8-1

Special-Status Plant Species

PLANTS	STATUS				MANAGEMENT CONCERNS	
Species	State	Federal	CNPS	Source	Habitat	Potential Threats
Phacelia insularis var. *continentis* North Coast phacelia	--	--	1B	8	Sandy soils, bluffs, coastal dunes, coastal bluffs, and coastal scrub.	Foot traffic, non-native plants, and grazing.
Piperia candida White-flowered rein orchid	--	--	4	8	Open to shaded sites, generally coniferous forests, sometimes serpentinite.	Limited distribution.
Pityopus californicus California pinefoot	--	--	4	6,8	Mixed or coniferous forest.	Logging.
Ribes victoris Victor's gooseberry	--	--	4	8	Canyon forests; broadleaved, upland forest; and chaparral.	Limited distribution.
Sidalcea hickmanii ssp. *viridis* Marin checkerbloom	--	--	1B	6,8	Chaparral and serpentinite.	Development.
Stebbinsoseris decipiens [Microseris decipiens] Santa Cruz microseris	--	--	1B	8	Broadleaved, upland forests; chaparral; coastal prairie and scrub; and open, sandy, shale, or serpentine sites.	Grazing.
Streptanthus batrachopus Tamalpais jewel-flower	--	--	1B	8	Chaparral, closed-cone coniferous forests with serpentine soils, and serpentine barrens.	Rare throughout its range.
Streptanthus brachiatus ssp. *brachiatus* Socrates Mine jewel-flower	--	--	1B	3,8	Closed-cone coniferous forests and chaparral with serpentine soils.	Rare throughout its range.

Notes and sources are at the end of the table.

Table 4.8-1

Special-Status Plant Species

PLANTS	STATUS				MANAGEMENT CONCERNS	
Species	**State**	**Federal**	**CNPS**	**Source**	**Habitat**	**Potential Threats**
Streptanthus brachiatus ssp. *hoffmanii* Freed's jewel-flower	--	--	1B	8	Serpentine barrens, chaparral, and open woodlands.	Rare throughout its range.
Streptanthus glandulosus var. *hoffmanii [S. glandulosus* ssp. *secundus]* Secund jewel-flower	--	--	1B	8	Chaparral, cismontane woodlands, serpentine and non-serpentine soils.	Rare throughout its range.
Streptanthus morrisonii ssp. *elatus* Three Peaks jewel-flower	--	--	1B	6,8	Serpentine barrens, chaparral, open woodlands, and cypress/knobcone pine woodlands.	Rare throughout its range.
Streptanthus morrisonii ssp. *hirtiflorus* Dorr's Cabin jewel-flower	--	FC	1B	2,5,8	Serpentine barrens, chaparral, open woodlands, and cypress/knobcone pine woodlands.	Limited distribution.
Streptanthus morrisonii ssp. *kruckebergii* Kruckeberg's jewel-flower	--	--	1B	8	Cismontane woodlands, serpentine barrens, chaparral, and cypress/knobcone pine woodlands.	Gold mining.
Streptanthus morrisonii ssp. *morrisonii* Morrison's jewel-flower	--	--	1B	8	Serpentine barrens, chaparral, and cypress/knobcone pine woodlands.	Rare throughout its range.
Streptanthus niger Tiburon jewel-flower	SE	FPE	1B	1,2,5,8	Valley-foothill grasslands with serpentine soils, and outcrops in grassland.	Road construction, foot traffic, and development on Tiburon Peninsula.
Tracyina rostrata Beaked tracyina	--	--	1B	8	Cismontane woodland, valley-foothill grasslands, and grassy slopes.	Rare throughout its range.
Trifolium amoenum Showy Indian clover	--	FPE	1B	2,3,5,8, 10	Valley-foothill grassland; heavy soils, disturbed soils.	Urbanization and agriculture.

Table 4.8-1

Special-Status Plant Species

PLANTS	STATUS				MANAGEMENT CONCERNS	
Species	State	Federal	CNPS	Source	Habitat	Potential Threats
Triphysaria floribunda [Orthocarpus floribunda] San Francisco owl's-clover	--	--	1B	8	Coastal prairie, valley-foothill grasslands; on serpentine slopes.	Grazing and trampling.
Veratrum fimbriatum Fringed false-hellebore	--	--	4	8	Meadows, coastal scrub, and North Coast forest (mesic).	Limited distribution.

Source: Harland Bartholomew & Associates, Inc., 1996

Notes:

1. State status data taken from Endangered, Threatened, and Rare Plants of California and Listing Dates (CDFG, Revised January 1996) and Special Animals (CDFG, Revised January 1996).
   - SE = State listed Endangered
   - ST = State listed Threatened
   - SR = State listed Rare
   - SCE = State Candidate Endangered
   - SSC = Species of Special Concern
   - CFP = Listed as Fully Protected by the CDFG
2. Federal status and probable distribution in Marin and Sonoma counties determined by correspondence with Laurie Simons-USFWS, 9 February 1994.
   - FE = Federally listed Endangered
   - FT = Federally listed Threatened
   - FPE = Federally Proposed Endangered
   - FC = Candidate: Taxa for which the USFWS has sufficient biological information to support a proposal to list as endangered or threatened.
3. CNDDB = California Natural Diversity Data Base, CDFG, 15 March 1995.
4. Distribution of State Listed species and Species of Special Concern confirmed with California Statewide Wildlife Habitat Relationships System, CDFG April 1996.
5. USFWS letter from Cay Goude, 16 February 1995.
6. Species requested to be included by Caitlin Bean, CDFG Biologist, Region 3.
7. USFWS letter from Joel Medlin, 22 June 1995.
8. CNPS Inventory of Rare and Endangered Vascular Plants of California (CNPS, 1994).
9. USFWS Plant Taxa for Listing as Endangered or Threatened Species; Notice of Review (Federal Register 58(188): 51144-51190, 30 September 1993).
10. USFWS Plant Taxa for Listing as Endangered Species; Proposed Rule (Federal Register 60 (148): 39314-39326, 2 August 1995)

California Native Plant Society (CNPS) Listing Categories:
List 1B = Plants Rare, Threatened, or Endangered in California and Elsewhere.
List 3 = Plants about which more information is needed - A Review List.
List 4 = Plants of limited distribution - A Watch List.

Habitat Sources:
CDFG Natural Heritage Program, Natural Diversity Data Base, 23 December 1993.
EIP Associates. December 1990 Santa Rosa Sub-Regional Water Reclamation System "Long-Term Wastewater System Draft Environmental Impact Report/Statement."
Holland, Robert F. 1986 Preliminary Descriptions of the Terrestrial Natural Communities of California, CDFG.

Note: In a series of recent federal register notices (50 CFR Part 17, Volume 61, Number 40, 7457-7463 and 7595-7613, February 28, 1996) the USFWS reclassified 96 candidate taxa of plants and animals. There is no longer a federal candidate category 2 status, there are now 182 plant and 89 animal taxa on a single candidate species list. The taxa on this list are considered by the USFWS as candidates for possible addition to the List of Endangered and Threatened Plants and Animals. As a consequence, the status of many taxa originally included in the analysis has changed, requiring that many taxa be removed from the list being considered in this EIR/EIS. See Biological Resources Technical Memorandum, Volume II for the original list and further clarification.

Table 4.8-2

Special-Status Animal Species

	STATUS				MANAGEMENT CONCERNS	
Species	**State**	**Federal**	**Other**	**Source**	**Habitat**	**Potential Threats**
REPTILES						
Phrynosoma coronatum frontale California horned lizard	SSC	--	--	1,4	Sandy open areas in riparian woodland, grassland, coastal scrub, mixed chaparral, and oak woodland.	Habitat loss and loss of native ant prey base.
BIRDS						
Accipiter cooperii Cooper's hawk	SSC	--	--	1,4	Prefers riparian habitat for nesting, primarily in the foothills and valleys.	Pesticide poisoning, and habitat loss and degradation.
Accipiter striatus Sharp-shinned hawk	SSC	--	--	1,4	Prefers broken woodlands of coniferous, deciduous, or mixed forests as nesting habitat.	Pesticide poisoning, and habitat loss and degradation.
Agelaius tricolor Tricolored blackbird	SSC	--	--	1,2,4,5	Nesting habitat primarily consists of freshwater marshes with dense stands of cattails or bulrushes; occasionally utilizes willows, thistles, mustard, blackberry thickets, and dense shrubs and grains for nesting as well.	Pesticide poisoning, and habitat loss and degradation.

Notes and sources are at the end of the table.

Table 4.8-2

Special-Status Animal Species

Species	STATUS				MANAGEMENT CONCERNS	
	State	Federal	Other	Source	Habitat	Potential Threats
Amphispiza belli belli Bell's sage sparrow	SSC	--	--	1,6	Chaparral in the inner Coast Range.	Habitat loss and degradation.
Aquila chrysaetos Golden eagle	SSC CFP	--	--	1,4	Nests primarily on cliffs or in tall trees; forages in open country, large portions of Area of Indirect Impacts may serve as foraging habitat.	Poisoning of prey species, and habitat loss and degradation.
Asio flammeus Short-eared owl	SSC	--	--	1,4	Inhabits swamplands, freshwater and saltwater marshes; nests in dense tule patches or stands of tall grasses.	Habitat destruction due to agricultural and urban development.
Buteo regalis Ferruginous hawk	SSC	--	--	1,2,4,5	Winter foraging habitat includes valley-foothill grassland, agricultural lands, and pastures; nests rarely in extreme northeastern California.	Habitat degradation and loss.
Circus cyaneus Northern harrier	SSC	--	--	1,4	Nests in coastal freshwater and saltwater marshes; forages in grasslands and marshes.	Habitat destruction due to agricultural and urban development.

Notes and sources are at the end of the table.

Table 4.8-2

Special-Status Animal Species

	STATUS				MANAGEMENT CONCERNS	
Species	**State**	**Federal**	**Other**	**Source**	**Habitat**	**Potential Threats**
Dendroica petechia Yellow warbler	SSC	--	--	1,4	Coastal and valley riparian forests and woodlands.	Habitat degradation and loss, and brood parasitism.
Elanus leucurus White-tailed kite	CFP	--	--	1,4	Grasslands, agricultural lands, meadows, and marshes for foraging. Nests and perches in dense topped trees.	Habitat destruction due to agricultural and urban development.
Falco columbarius Merlin	SSC			1	Foraging habitat includes brackish and freshwater marsh, salt ponds, grassland, oak woodland, and agricultural land.	
Falco mexicanus Prairie falcon	SSC			1	Foraging habitat includes freshwater marsh, grassland, and agricultural land.	Loss of foraging habitat, human disturbance at eyries, and shooting.
Geothlypis trichas sinuosa Salt marsh common yellowthroat	SSC	--	--	1,2,3,4, 5	Fresh and saltwater marshes; needs thick continuous cover down to the water surface for foraging.	Habitat degradation and loss.

Notes and sources are at the end of the table.

Table 4.8-2

Special-Status Animal Species

	STATUS				MANAGEMENT CONCERNS	
Species	**State**	**Federal**	**Other**	**Source**	**Habitat**	**Potential Threats**
Icteria virens Yellow-breasted chat	SSC	--	--	4	Inhabits dense riparian habitats.	Brood parasitism and habitat degradation and loss.
Lanius ludovicianus Loggerhead shrike	SSC	--	--	1	Foraging habitat includes annual grassland, cropland, and pasture.	Loss of habitat due to development and pesticide poisoning.
Laterallus jamaicensis coturniculus California black rail	ST	--	--	1,2,3,4, 5	Inhabits salt, brackish, and freshwater marshes bordering larger bays and rivers.	Habitat destruction and loss, introduced predators, and pesticide poisoning.
Pandion haliaetus Osprey	SSC	--	--	1,3,4	Nests in tall trees near freshwater lakes, reservoirs, large rivers, estuaries, and bays.	Pesticide poisoning, and habitat degradation and loss.
Phalacrocorax auritus Double-crested cormorant	SSC	--	--	1,3,4	Inhabits large freshwater lakes, reservoirs, rivers, bays, marshes, and the immediate sea coast.	Pesticide poisoning.
Progne subis Purple martin	SSC	--	--	1	Nests in large trees with cavities near open foraging areas.	Habitat loss and loss of nesting sites due to competition with introduced birds.

Notes and sources are at the end of the table.

Table 4.8-2

Special-Status Animal Species

	STATUS				MANAGEMENT CONCERNS	
Species	**State**	**Federal**	**Other**	**Source**	**Habitat**	**Potential Threats**
Rallus longirostris obsoletus California clapper rail	SE	FE	--	1,2,3,4, 5	Inhabits salt marshes composed primarily of pickleweed and cordgrass.	Habitat destruction and introduced predators.
Speotyto cunicularia hypugea Western burrowing owl	SSC	--	--	1,3,4	Valley-foothill grasslands.	Habitat destruction due to agricultural and urban development.
MAMMALS						
Antrozous pallidus Pallid bat	SSC	--	--	1,5	Inhabits open lowland areas below 6,000 feet.	Habitat loss, pesticide use, and roost-site disturbance.
Bassariscus astutus Ringtail	CFP	--	--	1,4	Inhabits riparian systems with moderately dense understories and rocky outcrops.	Habitat destruction due to agricultural and urban development.

Notes and sources are at the end of the table.

Table 4.8-2

Special-Status Animal Species

	STATUS				MANAGEMENT CONCERNS	
Species	**State**	**Federal**	**Other**	**Source**	**Habitat**	**Potential Threats**
Eumops perotis californicus Greater western mastiff-bat	SSC	--	--	1,2,4,5	Breeds in rugged, rocky canyons and forages in a variety of habitats.	Habitat loss, pesticide use, and roost-site disturbance.
Plecotus townsendii townsendii Pacific western big-eared bat	SSC	--	--	1,2,4,5	Inhabits oak and conifer woodlands, conifer and broadleaved forests, arid grasslands, deserts, and high mountain meadows.	Habitat loss, pesticide use, and human disturbance of maternity and night roosts.
Reithrodontomys raviventris Saltmarsh harvest mouse	SE CFP	FE	--	1,2,3,4,5	Restricted to salt marshes of San Francisco Bay and its tributaries.	Habitat loss and degradation.

Source: Harland Bartholomew & Associates, Inc., 1996

Notes:

1. State status data taken from Endangered and Threatened Animals of California (CDFG, Revised January 1996) and Special Animals (CDFG, Revised August 1994). ("Special Animals" is a broad term that refers to all the vertebrate and invertebrate taxa of concern to the Natural Diversity Data Base, regardless of their legal status or protection status).
   SE = State listed Endangered
   ST = State listed Threatened
   SCE = State Candidate Endangered
   SSC = Species of Special Concern
   CFP = Listed as Fully Protected by the CDFG
   * = CDFG is currently tracking this species

2. Federal status and probable distribution in Marin and Sonoma counties determined by correspondence with Laurie Simons-USFWS, 9 February 1994.
   FE = Federally listed Endangered
   FT = Federally listed Threatened
   FPE = Federally Proposed Endangered

FC = Federal Candidate: Taxa for which the USFWS has sufficient biological information to support a proposal to list as endangered or threatened.

3. CNDDB = California Natural Diversity Data Base, CDFG, 15 March 1995.

4. Distribution of State Listed species and Species of Special Concern confirmed with California Statewide Wildlife Habitat Relationships System, CDFG April 1996.

5. USFWS letter from Cay Goude, 16 February 1995.

6. USFWS letter from Joel Medlin, 22 June 1995.

Habitat Sources:
CDFG Natural Heritage Program, Natural Diversity Data Base, 23 December 1993.
EIP Associates. December 1990 Santa Rosa Sub-Regional Water Reclamation System "Long-Term Wastewater System Draft Environmental Impact Report/Statement."
Holland, Robert F. 1986 Preliminary Descriptions of the Terrestrial Natural Communities of California, CDFG.

Note: In a series of recent federal register notices (50 CFR Part 17, Volume 61, Number 40, 7457-7463 and 7595-7613, February 28, 1996) the USFWS reclassified 96 candidate taxa of plants and animals. There is no longer a federal candidate category 2 status, there are now 182 plant and 89 animal taxa on a single candidate species list. The taxa on this list are considered by the USFWS as candidates for possible addition to the List of Endangered and Threatened Plants and Animals. As a consequence, the status of many taxa originally included in the analysis has changed, requiring that many taxa be removed from the list being considered in this EIR/EIS. See Biological Resources Technical Memorandum, Volume II for the original list and further clarification.

- animals listed as "fully protected" in the Fish and Game Code of California (Sections 3511, 4700, 5050 and 5515) ; and

- plants listed in the California Native Plant Society's *Inventory of Rare and Endangered Vascular Plants of California* (1994).

Special-status plant and animal species that were identified by regulatory agencies, private organizations, and other interested parties as potentially affected by implementation of the Project but deemed by Project biologists as being out of range or to have extremely low potential for occurrence within the Area of Indirect Impacts, are not presented in Table 4.8-1 and Table 4.8-2. These species are compiled in comprehensive potential special-status species lists for the Area of Indirect Impacts and are addressed in the *Biological Resources*, Special-Status Species Accounts, *Volume 2* (Harland Bartholomew & Associates, Inc. 1996b).

The terrestrial biological resources of Sonoma and Marin counties within the Area of Indirect Impacts are described below and are identified in association with the dominant plant communities and wildlife habitats. The acreage of each sensitive plant community and wildlife habitat identified within the Area of Indirect Impacts is presented in the Environmental Consequences (Impacts) and Recommended Mitigation section. The acreages of all plant communities and wildlife habitats are presented in the *Biological Resources, Volume 1-4* (Harland Bartholomew & Associates, Inc. 1996a-f).

Plant Communities

Plant communities are assemblages of plant species that occur together in the same area. Plant communities are defined by species composition and relative abundance. Due to the unique hydrogeological nature of the region, a singular classification system does not provide an adequate description of the regions' plant communities. The plant community descriptions and nomenclature used in this analysis were based primarily on Holland (1986) and Shuford and Timossi (1989). The Holland system is not entirely applicable to all of the communities found in the Area of Indirect Impacts. The community descriptions of Shuford and Timossi (1989), which focus on the plant communities of Marin County, were therefore used to augment the Holland classification scheme. An "Agricultural Community" classification, which is not used by Holland or Shuford and Timossi, is included to describe four common and abundant community types in the Area of Indirect Impacts (i.e., cropland, orchard, vineyard, and pasture). An "Other Tree Communities and Associations" is also used in this section to describe non-native tree communities and associations, or monotypic associations of native trees, which are not addressed by Holland or Shuford and Timossi.

The plant communities are divided into five types: agricultural communities; grassland communities; shrub dominated communities; tree dominated communities; and other tree communities and associations. These plant communities are further differentiated into types (e.g., riparian woodland) and subtypes (e.g., willow riparian and mixed riparian).

Subtypes are only included when there are discernible or unique differences in their characteristics which warrant separate treatment in the impacts and mitigation analysis.

Agricultural Communities

Cropland

Croplands are located on flat to gently rolling terrain which is tilled prior to commencement of crop production (Zeiner 1988). Due to the artificially controlled growth and harvesting regime, croplands do not conform to normal seral stages (i.e., growth stage of habitat). These habitats may either be annual or perennial depending upon the crop-rotation system and geographic location. Crops grown in the Area of Indirect Impacts include hay, wheat, corn, potatoes, squash, and pumpkins and other truck crops. There are no special-status plant species associated with croplands.

Orchard

Orchards are generally found on valley floors which have rich, alluvial soils. They also may occur on rolling foothills and fairly steep slopes. Typical elevations for orchards range from sea level up to 3,000 feet above mean sea level (amsl) in areas that are normally frost-free. Orchards in California are dominated by a single tree species. Spacing between trees is uniform, and the understory is usually composed of low-growing grasses and other herbaceous plants (Schultze 1988). Typical orchards in the Area of Indirect Impacts include apple orchards and peach orchards. There are no special-status plant species specifically associated with orchards.

Pasture

Pastures are usually grown on flat to gently sloping land and may be irrigated in some manner. The length of a growing season for a particular pasture will depend upon the crop type and climatic influences. Pastures are maintained by man and are usually composed of a mix of perennial grasses and legumes that provide 100 percent ground cover. Old or poorly drained pastures may also have patches of weedy species (Zeiner 1988). This community is maintained to provide forage for a variety of livestock including cattle, sheep, and horses. In northern California, ryegrass (*Lolium* spp.), tall fescue (*Festuca arundinacea*), Dallisgrass (*Paspalum dilatatum*), Ladino clover (*Trifolium repens*), and trefoils (*Lotus* spp.) are preferred pasture plant species (George et al. 1980; Zeiner 1988). There are a few special-status plant species that can be associated with pastures. For example, in the Santa Rosa Plain, special-status species such as Sebastopol meadowfoam, Burke's goldfields, and Douglas' pogogyne are known to occur in seasonal wetlands in lightly grazed pastures (Betty Guggolz, California Native Plant Society, personal communication, December 2, 1995).

Vineyard

Vineyards are also generally found on alluvial soils of valley floors, but may also occur in the foothills at elevations up to 3,000 feet. Vineyards are typically composed of a single shrub species planted in rows and are usually supported on wood and wire trellises. Vines are normally intertwined in the rows, but there is open space between rows which may be planted with grasses or other herbaceous plants to prevent soil erosion. Vineyards are usually long-lived and may persist for over 40 years (Schultze 1988). There are no special-status plant species associated with vineyards.

Grassland Communities

Annual Grassland

Annual grasslands are virtually treeless areas dominated by non-native annual grasses. Annual grasslands occur from sea level to about 3,600 feet (Kie 1988). In California, annual grasslands occur throughout the Central Valley, Coast Range as far north as Mendocino County, and scattered locations in southern California.

Annual changes in rainfall and grazing have a profound effect on the species composition of annual grassland during a given year. Growth typically starts with the first fall rains. Slow growth is maintained throughout winter, followed by rapid growth in spring. During years of favorable rainfall and little or no grazing pressure, large amounts of standing dead plant material can be found during the summer months. A moderate level of livestock grazing may preserve botanical diversity and is considered beneficial (Kie 1988). In the absence of grazing, annual grasslands are often limited in diversity and dominated by tall, dense stands of invasive grasses such as ripgut brome (*Bromus diandrus*) or wild oats (*Avena* sp.), and scattered trees or clumps of trees.

Although the proportion and density of native plant species occurring within annual grassland is typically low, there are some special-status plant species which may be found in this community. These species include Brewer's milk-vetch, Clara Hunt's milk-vetch, Tiburon Indian paintbrush, and Vine Hill clarkia.

Coastal Prairie

Coastal prairie, also referred to as coastal terrace prairie (Holland 1986) and Festuca-Danthonia grassland (Shuford and Timossi 1989), occurs in sandy loams on marine terraces near the coast. Strong maritime influences produce frequent fog events resulting in reduced evapotranspiration and promoting the growth of perennial bunchgrasses (Shuford and Timossi 1989). Coastal prairies occur in the coastal portions of the region, such as the vicinity of the Estero Americano and Estero de San Antonio. Most stands are quite patchy and variable in composition, reflecting local differences in available soil moisture capacity (Holland 1986). A

higher proportion of native species is usually present in coastal prairies than in annual grasslands.

Coastal terrace prairie has been identified by the California Department of Fish and Game as a sensitive natural community (California Department of Fish and Game 1995). Special-status plant species found in this plant community include Blasdale's bent grass.

Native Grassland

Native grasslands are treeless areas dominated by perennial bunchgrass species. In northern California, relict perennial bunchgrasses such as purple needlegrass (*Nassella pulchra*) and wild blue rye (*Elymus glaucus*) occupy areas with greater precipitation and light grazing.

Annual, non-native grasses have replaced most of the native, perennial bunchgrasses that once dominated lower elevations throughout North America. One of the main factors that shifted the competitive advantage from native to non-native grasses appears to be the inability of native grasses to successfully compete under heavy grazing conditions (Barry 1972). Due to the historic use of grasslands, most stands of native grasses in the region now occur as small, isolated populations. The use of these grasslands for grazing has also limited the population and distribution of species endemic to this community, resulting in many species receiving protected status. Some of the special-status plant species associated with native grasslands include Colusa layia, woolly-headed lessingia, San Francisco wallflower, fragrant fritillary, and bristly linanthus. Valley needlegrass grassland and serpentine bunchgrass are types of native grassland that are considered sensitive natural communities by the California Department of Fish and Game (California Department of Fish and Game 1995).

Shrub Dominated Communities

Chaparral (Chamise Chaparral, Manzanita Chaparral, Mixed Chaparral, and Serpentine Chaparral)

Chaparral is composed of evergreen woody shrubs that form extensive low shrublands on the hills and lower mountain slopes of California (Hanes 1977, Holland 1986). Chaparral is found on nutrient-poor, rocky soils on dry inland hills (Shuford and Timossi 1989). Four types of chaparral communities occur in the region. These four communities include chamise chaparral, manzanita chaparral, mixed chaparral, and serpentine chaparral (Shuford and Timossi 1989). These community types also intergrade within the region. Species that grow in chaparral communities are hardy and are able to withstand severe environmental factors such as frequent fires, low water availability, and high magnesium, calcium, and iron concentrations in soils.

Chamise chaparral is the dominant type of chaparral throughout California (Hanes 1977). This community type is found on hot dry sites, usually on south- or west-facing slopes and ridges (Hanes 1977). Stanford manzanita and buck brush occasionally occur intermixed with the chamise. Special-status plants which may be associated with chamise chaparral include Brewer's calandrinia, Vine Hill ceanothus, Vine Hill clarkia, western dichondra, and thin-lobed horkelia.

Manzanita chaparral is found on deeper soils and at higher elevations than chamise chaparral. Manzanita chaparral often forms thick, almost impenetrable stands (Hanes 1977). Special-status plant species associated with manzanita chaparral include Sonoma manzanita, Rincon manzanita, and Marin manzanita.

Mixed chaparral occurs on mesic (moist soil) sites and usually grades into mixed evergreen forest on moist, shady slopes or in drainages (Shuford and Timossi 1989). Mixed chaparral consists of an almost even mix of interior live oak (*Quercus wislizenii* var. *wislizenii*), manzanita, chamise, and buck brush (Shuford and Timossi 1989). Special-status plant species associated with mixed chaparral include bent-flowered fiddleneck, Sonoma ceanothus, western leatherwood, nodding madia, and robust monardella.

Serpentine chaparral is an open, low type of chaparral associated with serpentine soils (Hanes 1977). The dominant shrubs in this community include chamise, toyon (*Heteromeles arbutifolia*), and leather oak. Tree species associated with this community include scrub oak and gray pine. Serpentine soils have very low levels of important nutrients such as calcium, phosphorus, and nitrogen, and high levels of magnesium, chromium, and nickel (Shuford and Timossi 1989; Kozloff and Beidleman 1994). Consequently, plant species occurring on these soils are usually dwarfed due to the poor growing conditions.

Serpentine chaparral is irregularly and locally distributed within the chaparral zone of the region. The impoverished soil that results from the breakdown of minerals present in serpentinite supports a variety of unique plant species (i.e., serpentine endemics) that contribute a significant portion of California's plant diversity. Examples of special-status plant species in the region that are limited primarily to serpentine soils are bent-flowered fiddleneck, Hopland manzanita, serpentine milkweed, serpentine reed grass, dwarf soaproot, serpentine bird's beak, Baker's manzanita, and The Cedars manzanita.

Northern Coastal Scrub

Northern coastal scrub is characterized by low to moderate-sized, semi-woody shrubs (one to six feet in height) with mesophytic leaves and shallow root systems (Harrison et al. 1971, Bakker 1971). Southern and western exposures with shallow, rocky soils support a relatively dense canopy with a well-developed understory of herbs and grasses. Species composition changes between mesic and

xeric sites and from north to south along the coast. In the Area of Indirect Impacts two types of northern coastal scrub are recognized: low-growing patches of bush lupine (*Lupinus succulentus*) near the ocean, and areas of coyote brush (*Baccharis pilularis*) in less exposed sites.

Several special-status plant species are associated with northern coastal scrub including San Francisco spineflower, woolly-headed spineflower, yellow larkspur, and coast rock cress. Coast rock cress is most often found on rocky outcrops in northern coastal scrub habitat (Betty Guggolz, CNPS, personal communication, December 2, 1995).

Tree Dominated Communities

Oak Woodland (Coast Live Oak/Interior Live Oak, Oak-Bay-Madrone)

Several species of tree oaks (*Quercus* spp.) occur in California, seven of which are found in the Area of Indirect Impacts. These seven oak species include coast live oak (*Quercus agrifolia* var. *agrifolia*), canyon live oak (*Q. chrysolepis*), blue oak (*Q. douglasii*), Oregon oak (*Q. garryana* var. *garryana*), California black oak (*Q. kelloggii*), valley oak (*Q. lobata*), and interior live oak (*Q. Wislizineii*). A predominance of deciduous oaks, open canopies, and grassy ground cover beneath and among the trees characterizes the oak woodlands in the Area of Indirect Impacts (Shuford and Timossi 1989).

Although various classifications have been devised to describe the oak woodland communities of California (e.g., Holland 1986; Griffin 1977, Pavlik et al. 1991), none of these classifications accurately describes the dominant oak woodland community type found within the Area of Indirect Impacts. The most common oak woodland community type occurring in the Area of Indirect Impacts consists of a mixture of coast live oak and interior live oak. Coast live oak is usually the dominant tree among these two species and this community is therefore identified as "coast live oak/interior live oak". This community intergrades with the oak-bay-madrone woodland community. The other species of tree oaks within the Area of Indirect Impacts occur as scattered, individual trees or as small stands of trees, consisting of one or more oak species.

In addition to the tree oak species listed above, two species of shrub oaks occur within the Area of Indirect Impacts (i.e., scrub oak [*Quercus dumosa*] and leather oak [*Quercus durata*]). These shrub oak species occur as a component of the chaparral community within the geysers reserve and at higher elevations along Pine Flat Road in Sonoma County.

Oak-bay-madrone woodland is a type of mixed evergreen forest dominated by closed-canopy stands of coast live oak, California bay (*Umbellularia californica*), and California madrone (*Arbutus menziesii*) (Shuford and Timossi 1989). Oak-bay-madrone woodland is a tall, dense community with few shrubs or low-

growing herbs (Pavlik et al. 1991). Oak-bay-madrone woodland generally occurs in moist, cool areas, but may also occur on drier sites (Shuford and Timossi 1989).

Special-status plant species associated with the oak woodlands within the Area of Indirect Impacts include bent-flowered fiddleneck, western dichondra, Diablo helianthella, Napa lomatium, robust monardella, and green monardella.

Redwood Forest

Redwood forest, also described as upland redwood forest is dominated by redwood (*Sequoia sempervirens*) (Holland 1986). Redwood forests grow on shallow, well-drained soils and very deep, alluvial floodplain soils in the Coast Range of California from San Luis Obispo County north to southwestern Oregon (McMinn and Maino 1981, Zinke 1977). Natural stands of redwood forest occur in Sonoma and Marin counties, and are present in scattered locations within the Area of Indirect Impacts (e.g., Sebastopol Agricultural Irrigation area). Individual redwood trees are a popular horticultural tree and are commonly planted along roadsides and in parks and yards (e.g., Carroll Road storage reservoir site). Special-status plant species that may occur within the redwood forest plant community include fringed false-hellebore, California pinefoot, and California bottle-brush grass.

Riparian Woodland (Willow Riparian, Mixed Riparian, and Non-wooded Riparian)

Riparian woodlands are complex habitats associated with perennial and intermittent creeks and streams. Riparian woodlands generally have closed canopies dominated by broadleaved, winter deciduous trees. The composition of species in riparian woodland communities is highly variable and dependent on geographic location, elevation, substrate, and amount of flow in the watercourse. Riparian woodland is a widespread community type scattered throughout the Central Valley of California, lower foothills of the Cascades, Sierra Nevada, and Coast Range, though it has been estimated that 95 percent of riparian woodlands have been eliminated in California (Grenfell 1988). Riparian woodlands occur on well-aerated, sandy, alluvial soils.

Willow riparian and mixed riparian are two types of riparian woodlands that occur in the Area of Indirect Impacts. Willow riparian is dominated by red willow (*Salix laevigata*) and arroyo willow (*S. lasiolepis*), whereas mixed riparian woodland is dominated by red alder (*Alnus rubra*) and big leaf maple (*Acer macrophyllum*). Evergreen hardwoods such as California bay and coast live oak commonly occur along the edges of riparian corridors where they gradually intergrade into adjacent grasslands. Further inland, red alder is replaced by white

alder (*Alnus rhombifolia*), Fremont's cottonwood (*Populus fremontii* ssp. *fremontii*), and valley oak.

The number of layers of understory vegetation depends on the age of the woodland, climate, and surrounding land uses. The density and diversity of the understory is often influenced by cattle grazing. Riparian woodlands that have been carefully managed or fenced from cattle support a significantly higher number of native species than those areas where cattle are allowed free access.

Riparian corridors that are mostly devoid of shrubs and trees (due to cattle grazing) are classified as non-wooded riparian habitats. These corridors occur mostly along intermittent watercourses. In the absence of cattle grazing, it is likely that these corridors will support at least some level of riparian community development.

Other Tree Communities and Associations

This section includes descriptions of other tree communities and associations of native and non-native trees that occur in scattered locations within the major vegetation community types (e.g. grasslands, riparian woodlands, and wetland communities) in the Area of Indirect Impacts. The tree species involved include eucalyptus (*Eucalyptus globulus*), Monterey pine (*Pinus radiata*), and Lombardy poplar (Populus nigra) non-native species; Monterey cypress (*Cypress macrocarpa*), a native species that is not indigenous to Sonoma or Marin counties; and California buckeye (*Aesculus californica*), a native species that occurs as individuals or in small groups.

California Buckeye (Buckeye)

California buckeye is a native California species that occurs on canyon slopes and in the low dry hills of the Sierra Nevada and Coast Range of California (McMinn and Maino 1981). Populations of California buckeye in Sonoma County occur in small, scattered populations in canyons and on hillsides in association with major community types such as grasslands, oak woodlands, and mixed hardwood forests. The species also occurs as an associate with coast live oak in narrow canyons along drainages.

Eucalyptus

The eucalyptus community is an example of a non-native, exotic plant community that has become naturalized in many locations in the Area of Indirect Impacts. Eucalyptus was introduced to California as an ornamental species and to provide lumber and windbreaks (Ornduff 1974). Monotypic (single species) stands of eucalyptus are common in the Area of Indirect Impacts, especially where the trees were planted in groves to serve as windbreaks. The groves are usually even aged with an open understory due to the allelopathic effects (inhibits growth of nearby

plants) of this genus. The most common species in this community is blue gum, which reaches heights up to 120 feet and trunk diameters of over five feet. Eucalyptus trees tend to replace natural riparian habitat when planted along creeks or natural drainages in the region.

Lombardy Poplar (Poplar)

The Lombardy poplar is not native to California. Although similar to the native cottonwood or poplar (*Populus fremontii* ssp. *fremontii*), Lombardy poplars have a columnar shape as compared to the open, spreading form of the native cottonwood. In the Area of Indirect Impacts, Lombardy poplars are planted in rows in scattered locations as a windbreak along property lines and hedgerows. They have also become established in scattered locations along drainages.

Monterey Cypress (Cypress)

The Monterey cypress is a native California species that has been widely planted outside its natural range on the Monterey Peninsula (Bartel 1993). This species is planted as hedges, windbreaks, and park trees (McMinn and Maino 1981).

Monterey Pine

The Monterey pine is a native California species that occurs in Santa Cruz and Monterey counties along California's central coast. This species has also been widely planted throughout coastal California. In the Area of Indirect Impacts, Monterey pines have been planted as hedge rows and wind breaks. These stands do not represent a distinct plant community type because they have been planted and are not indigenous to Sonoma County, however, the planted Monterey pines occur in large enough numbers to warrant mapping within the Project area.

Wildlife Habitats

The plant communities described above generally correlate with wildlife habitats within the Area of Indirect Impacts (see Plant Community/California Wildlife Habitat Relationships Habitat Type comparison presented in Table 4.8-3).

The wildlife habitats present within the Area of Indirect Impacts were described and mapped using the California Department of Fish And Game's California Wildlife Habitat Relationships System (CWHR) and the classification scheme developed by Mayer and Laudenslayer (1988). Wildlife habitat provides cover, food, and water necessary to meet the biological requirements of one or more individuals of an animal species (Bailey 1982). It is necessary to differentiate wildlife habitats from plant communities in order to assess more accurately how changes in habitats (e.g., change in seral stage within a particular habitat type or change from one habitat type to another) impact abundance, distribution, diversity, and interactions between species. Essential habitat elements which relate to the reproduction, foraging, and cover requirements of each wildlife species are

central to the Wildlife Habitat Relationship analysis. The wildlife habitats identified within the Area of Indirect Impacts are described below in terms of the assemblage of wildlife species that they support. The vegetative component of these wildlife habitats is addressed under the corresponding plant communities described above.

Table 4.8-3

Plant Community/Wildlife Habitat Relationship System Habitat Type Comparison

Plant Community	Corresponding CWHR Habitat[1]
Cropland	Cropland
Orchard	Orchard/Vineyard
Pasture	Pasture
Vineyard	Orchard/Vineyard
Annual Grassland	Annual Grassland
Coastal Prairie	N/A
Native Grassland	N/A
Chaparral	Mixed Chaparral
Northern Coastal Scrub	Coastal Scrub
Coastal Live Oak/Interior Live Oak Woodland	Coastal Oak Woodland
Oak-Bay Madrone Woodland	Montane Hardwood/Montane Hardwood-Conifer[2]
Redwood	Redwood
Willow Riparian	Valley Foothill Riparian
Mixed Riparian	Valley Foothill Riparian
Non-wooded Riparian	N/A
Buckeye	N/A
Eucalyptus	Eucalyptus
Poplar	Urban
Cypress	Urban
Monterey Pine	Urban

Source: "A Guide to Wildlife Habitats of California", 1988

Notes:
1 California Wildlife Habitat Relationship System. Habitats are grouped according to vegetative dominance or unique characteristics to which wildlife are thought to respond (Mayer and Laudenslayer 1988).
2 Montane hardwood-conifer habitats relate to oak-bay-madrone woodlands which are composed of at least one-third Douglas-fir.

Cropland

Although cropland generally provides low to moderate habitat value for wildlife, low-growing row crops and fallow fields may provide important foraging habitat for resident open-country hawk species such as American kestrel, and red-tailed hawk. Ferruginous hawk (*Buteo regalis*), rough-legged hawk (*Buteo lagopus*),

and prairie falcon (*Falco mexicanus*) also forage in fallow fields during the fall and winter months. Migratory waterfowl species such as Canada goose (*Branta canadensis*) may seasonally depend on croplands for foraging habitat.

Croplands are found in association with a variety of habitat types such as orchard-vineyard, pasture, annual grassland, valley foothill riparian, mixed chaparral, and fresh emergent wetland.

Orchard-Vineyard

Animal species which may use orchard or vineyard communities for cover, foraging, or breeding habitat include widespread species such as, western scrub jay (*Aphelocoma californica*), American crow (*Corvus brachrhynchos*), Brewer's blackbird (*Euphagus cyanocephalus*), mourning dove (*Zenaida macroura*), northern mockingbird (*Mimus polyglottus*), and California ground squirrel (*Spermophilus beecheyi*). No special-status animal species are associated with this man-made, cultivated habitat.

Orchards and vineyards may be associated with cropland, pasture, and urban wildlife habitats. They are also found near native habitats such as valley foothill riparian and mixed chaparral.

Pasture

Pastures may be utilized by a wide variety of wildlife species. However, the use of this habitat is dependent upon the geographic region and availability of adjacent habitat types. Waterfowl, ring-necked pheasant (*Phasianus colchicus*), California quail, (*Callipepla californica*) and other ground-nesting birds will nest in pastures if adequate vegetation is present at the start of the nesting season. Pastures that are flood-irrigated provide feeding and roosting sites for wetland-associated birds such as shorebirds, waterfowl, and some raptors. In addition, deer will graze in pastures if sufficient escape cover is available. Although there are no special-status animal species that are associated with pastures, overwintering ferruginous hawks and other special-status raptors often use pastures as foraging habitat.

Pastures are frequently associated with several other wildlife habitat types including cropland, annual grassland, and orchard-vineyard.

Annual Grassland

Relatively undisturbed annual grasslands provide nesting habitat for bird species such as western meadowlark (*Sturnella neglecta*) and horned lark (*Eremophila alpestris*), as well as the western burrowing owl (*Speotyto cunicularia hypugea*). This habitat produces large numbers of seeds that are shed and become available to bird species such as American pipit (*Anthus rubescens*), lark sparrow

(*Chondestes grammacus*), and savanna sparrow (*Passerculus sandwichensis*). Mammals that also forage on seeds and are found in this habitat include deer mouse (*Peromyscus maniculatus*), California vole (*Microtus californicus*), California ground squirrel, and Botta's pocket gopher (*Thomomys bottae*). These rodents also become the prey base for various resident raptors, such as golden eagle (*Aquila chrysaetos*), red-tailed hawk (*Buteo jamaicensis*), white-tailed kite (*Elanus leucurus*), and northern harrier (*Circus cyaneus*), that utilize wide, open grasslands as foraging habitat. Prairie falcons also forage in this habitat during the winter months. In addition, coyote (*Canis latrans*), Pacific gopher snake (*Pituophis melanoleucus catenifer*), western yellow-bellied racer (*Coluber constrictor mormon*), and western rattlesnake (*Crotalus viridis*) feed on seed-eaters in this community. Due to its extensive distribution, annual grassland intergrades with all of the different habitat types discussed in this section.

Under certain soil conditions, shallow depressions in annual grassland may fill with water during the rainy-season forming seasonal wetlands such as vernal pools. Vernal pools support a unique wildlife assemblage and plant community especially adapted to the annual cycle of seasonal inundation and desiccation. This seasonally dynamic community supports many endemic special-status animal and plant species and provides seasonal foraging habitat for shorebirds and waterfowl. Special-status species that are associated with vernal pools and other seasonal wetlands are discussed under Aquatic Biological Resources, Section 4.9.

Mixed Chaparral

Mixed chaparral provides important cover, foraging, and breeding habitat for many wildlife species. Characteristic bird species that utilize this habitat include wrentit (*Chamaea fasciata*), bushtit (*Psaltriparus minimus*), California quail, orange-crowned warbler (*Vermivora celata*), spotted towhee (*Pipilo maculatus*), California thrasher (*Toxostoma redivivum*), western scrub jay, and northern mockingbird. During the winter months, chaparral also provides suitable foraging habitat for Cooper's hawk (*Accipiter cooperii*) and sharp-shinned hawk (*Accipiter striatus*).

Chaparral also offers valuable foraging habitat and cover for wild pig (*Sus scofa*), black-tailed deer (*Odocoileus nemionus*), bobcat (*Felis rufus*), coyote (*Canis latrans*), brush rabbit (*Sylvilagus bachmani*), black-tailed jackrabbit (*Lepus californicus*), and California kangaroo rat (*Dipodomys californicus)*. Due to the relatively dry nature of the chaparral community, few if any amphibian species inhabit this community. However, chaparral does provide suitable shelter, basking sites, and foraging habitat for reptiles like the western rattlesnake, common kingsnake (*Lampropeltis getulus*), Pacific gopher snake, striped racer (*Masticophis lateralis*), and western fence lizard. Some of the special-status animal species that may be found in association with chaparral habitats in the

region include California horned lizard, ringtail (*Bassariscus astutus*), peregrine falcon (*Falco peregrinus*), and Bell's sage sparrow (*Amphisipiza belli*).

Mixed chaparral is found in association with coastal scrub, blue oak-gray pine woodland, coastal oak woodland, and annual grassland.

Coastal Scrub

Coastal scrub provides habitat for many bird species including California thrasher, bushtit, California quail, Swainson's thrush (*Catharus ustulatus*), Wilson's warbler (*Wilsonia pusilla*), and wrentit (*Chamaea fasciata*). White-crowned sparrow (*Zonotrichia leucophrys*), song sparrow (*Melospiza melodia*), Anna's hummingbird (*Calypte anna*), and Allen's hummingbird (*Selasphorus sasin*) may nest in the thick coastal scrub near the seashore. Birds that utilize coastal scrub as a foraging habitat include northern harrier, red-tailed hawk, common raven (*Corvus corax*), and turkey vulture (*Cathartes aura*). Mammals known to occur in coastal scrub include cottontail, black-tailed deer, striped skunk, coyote, bobcat, and the introduced red fox (*Vulpes vulpes*). Common amphibian and reptile species found in this community include western fence lizard, southern alligator lizard (*Elgaria multicarinatus*), western yellow-bellied racer, Pacific gopher snake, and western skink. Myrtle's silverspot butterfly is a special-status animal species associated with coastal scrub wildlife habitat.

At lower elevations, coastal scrub may be associated with annual grassland, perennial grassland, cropland, and pasture. At higher elevations, coastal scrub transitions into coastal oak woodland, montane hardwood, and mixed chaparral.

Coastal Oak Woodland

The wildlife habitat associated with coastal oak woodland is diverse. Oak acorns are an essential food resource for many wildlife species including western gray squirrel (*Sciurus griseus*), California ground squirrel, black-tailed deer (*Odocoileus hemionus*), wild pig (*Sus scrofa*), deer mouse, dusky-footed woodrat (*Neotoma fuscipes),* acorn woodpecker (*Melanerpes formicivorus*), band-tailed pigeon (*Columba fasciata*), northern flicker (*Colaptes auratus*), and western scrub jay. The abundant insect life found in the bark and foliage of oaks provide food for bird species such as white-breasted nuthatch (*Sitta carolinensis*), bushtit (*Psaltriparus minimus*), plain titmouse (*Parus inornatus*), and ash-throated flycatcher (*Myiarchus cinerascens*). Avian predators that nest and forage in the coast oak woodland habitat include great horned owl (*Bubo virginianus*), western screech-owl (*Otus kennicotti*), red-tailed hawk, and red-shouldered hawk (*Buteo lineatus*).

Oak trees and other hardwoods in this community provide shelter, shade, and breeding habitat for many wildlife species, including raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), cottontail (*Sylvilagus audubonii*), and gray fox

(*Urocyon cinereoargenteus*). A variety of woodpecker species are primary-cavity nesters in oak trees, while house wren (*Troglodytes aedon*), western bluebird (*Sialia mexicana*), and American kestrel (*Falco sparverius*) are secondary-cavity nesters (i.e., utilizing abandoned woodpecker cavities).

Typical amphibian and reptile species that utilize this habitat include ensatina (*Ensatina eschscholtzi*), western skink (*Eumeces skiltonianus*), California slender salamander (*Batrachoseps attenuatus*), arboreal salamander (*Aneides lugubris*), sharp-tailed snake (*Contia tenuis*), ringneck snake (*Diadophis punctatus*), Pacific tree frog (*Pseudacris regilla*), western terrestrial garter snake (*Thamnophis elegans*), western fence lizard (*Sceloporus occidentalis*), and northern alligator lizard (*Elgaria coeruleus*).

Cooper's hawk, white-tailed kite, golden eagle, and northwestern pond turtle are special-status wildlife species that may be found in association with oak woodlands.

Montane Hardwood

Montane hardwood habitat provides resources for many species of forest birds and mammals. Bark and leaf-gleaning insectivores (e.g., white-breasted nuthatch and chestnut-backed chickadee [*Parus rufescens*]) are common residents of montane hardwood habitat, as are birds and mammals that feed primarily on the abundant acorn crops (e.g., wild turkey [*Meleagris gallopavo*], band-tailed pigeon, western scrub jay, acorn woodpecker, western gray squirrel, and black-tailed deer). Sharp-tailed snake, ensatina, and western fence lizard are reptile and amphibian species found in montane hardwood habitat. Many of these species are prey for mammalian and avian predators such as ringtail (*Bassarisus astuts*), gray fox, Cooper's hawk, and red-shouldered hawk. Mature trees and snags provide habitat for cavity-nesting birds (e.g., northern flicker) and mammals (e.g., raccoon) while raptors such as red-tailed hawk and golden eagle often nest near the tops of large conifers.

This habitat often transitions with valley foothill conifer habitat at lower elevations. At middle elevations, montane hardwood habitat interfaces with mixed chaparral. Common associated habitats include valley foothill riparian, annual grassland, and mixed chaparral.

Montane Hardwood-Conifer

Montane hardwood conifer woodlands typically occur on coarse, well-drained mesic soils, often in mountainous terrain with narrow valleys (Mayer and Laudenslayer 1988). This particular habitat type is well-represented in regions with cool, wet winters and warm, dry summers.

Montane hardwood conifer woodlands occur throughout California, and are somewhat continuous from Santa Cruz County north through the outer coast range into Oregon (Cheatham and Haller 1975). Elevations range from 1,000 to 4,000 feet in the north and 2,000 to 5,800 feet in the south (Mayer and Laudenslayer 1988).

Montane hardwood conifer woodlands include at least one-third conifers and one-third broad-leaved-hardwoods (Anderson et al. 1976). The habitat often occurs in a mosaic-like pattern with small pure stands of conifers interspersed with small stands of broad-leaved trees (Sawyer 1980). Montane hardwood conifer habitat represents a transition between hardwood-dominated habitats and conifer-dominated habitats and provides a high degree of vegetational diversity. Typical conifer species include Douglas-fir, incense cedar, Ponderosa pine, and gray pine, while typical hardwood species include Oregon oak, California black oak, California bay-laurel, Pacific madrone, coast live oak, and canyon live oak (Mayer and Laudenslayer 1988). These species will vary depending upon the elevation and geographical area.

Normally, conifers form the upper canopy, while hardwoods comprise the lower canopy. There is usually minimal understory associated with the denser stands of montane hardwood conifer habitat. However, annual grassland, valley foothill riparian, and mixed chaparral may intergrade with this habitat depending upon the conditions.

Montane hardwood conifer woodlands provide foraging and breeding habitat for a variety of wildlife species. Wildlife species associated with montane hardwood habitat are also associated with montane hardwood conifer habitat. However, bird species such as northern pygmy owl (*Glaucidium gnoma*), brown creeper (*Certhia americana*), pileated woodpecker (*Dryocopus pileatus*), and Hutton's vireo (*Vireo huttoni*) are more likely to be found in montane hardwood conifer habitat.

Redwood

Redwood forest is known to provide cover, food, and breeding habitat for at least 193 species of wildlife Bird species typically found in this habitat type include pileated woodpecker, northern pygmy-owl, Allen's hummingbird, Pacific-slope flycatcher (*Empidonax difficilis*), brown creeper, winter wren (*Troglodytes troglodytes*), Wilson's warbler, and dark-eyed junco (*Junco hyemalis*). Other animals inhabiting the various seral stages of redwood forest include striped skunk, western gray squirrel, ringtail, Oregon salamander (*E. e. oregonensis*), black salamander (*Aneides flavipunctatus*), Pacific giant salamander (*Dicamptodon ensatus*), California slender salamander, and Coast garter snake (*Thamnophis elegans terrestris*). Foothill yellow-legged frog is a special-status animal species found in drainages associated with redwood forest habitats and is discussed in Section 4.9, Aquatic Biological Resources.

Valley Foothill Riparian

Riparian woodland can support more species (i.e., more than 250 species) than any other terrestrial habitat type in the Area of Indirect Impacts (Grenfell 1988). Riparian woodland provides abundant food, cover, and breeding sites for wildlife in close proximity to water. These factors and the structural diversity of riparian woodland are largely responsible for the high productivity of this habitat type. Bird species that are characteristic of this habitat include California quail, mourning dove, Nuttall's woodpecker (*Picoides nuttallii*), black phoebe (*Sayornis nigricans*), western wood-pewee (*Contopus sordidulus*), California towhee (*Pipilo crissalis*), and song sparrow. A number of these species nest or roost in riparian woodland and feed in adjacent habitat types, such as annual grassland and agricultural fields. Riparian woodlands also provide important feeding, resting, and nesting habitat for neotropical migrant songbirds such as warblers, vireos, grosbeaks, and flycatchers.

Mammals found within riparian woodland habitat may include opossum, raccoon, deer mouse, broad-footed mole (*Scapanus latimanus*), striped skunk, gray fox, and ringtail. Amphibians and reptiles that are likely to occur in this community include California newt (*Taricha torosa*), western toad (*Bufo boreas*), Pacific tree frog, common king snake, western aquatic garter snake, and western skink.

Riparian woodlands also provide nesting and foraging habitat for a variety of special-status wildlife species including Cooper's hawk, yellow warbler, white-tailed kite, and yellow-breasted chat. Although there are historical nesting records for long-eared owl along the Russian River in Sonoma County, this species is currently only a rare fall and winter visitor to riparian habitat within the County (Burridge 1995).

In addition to providing high value wildlife habitat, riparian corridors provide local movement corridors between fragmented habitat patches, and necessary habitat for migrant wildlife species such as neotropical migrant songbirds. Due to the value and scarcity of riparian woodlands, on both a state and region-wide scale, they are considered a sensitive habitat type and monitored closely by the California Department of Fish and Game.

The valley foothill riparian habitat is found in association with riverine, grassland, (annual and perennial), coastal oak woodland, and agricultural habitats. The transition to a non-riparian habitat is usually abrupt, especially in agricultural areas. At higher elevations valley foothill riparian habitat intergrades with montane riparian habitat.

Eucalyptus

The lack of plant species diversity within the eucalyptus wildlife habitat results in a corresponding limited wildlife species diversity. Wildlife species that inhabit

this habitat type are generalists that utilize a wide variety of habitat types. Bird species that utilize this habitat as nesting or roosting habitat include red-tailed hawk, red-shouldered hawk, great horned owl, American crow, house finch (*Carpodacus mexicanus*), European starling (*Sturnus vulgaris*), Anna's hummingbird, turkey vulture, blue jays, and house sparrow (*Passer domesticus*). Mammals which may occur in eucalyptus groves include opossum (*Didelphis virginiana*), raccoon, house mouse (*Mus musculus*), Norway rat (*Rattus norvegicus*), and striped skunk. Western fence lizard, Pacific slender salamander, Pacific gopher snake, and southern alligator lizard are common reptile and amphibian species found in this habitat.

There are no special-status animal species that are associated with eucalyptus wildlife habitat. However, monarch butterflies may form colonial roosts in large, wind-protected groves of eucalyptus trees during migration.

Urban

A distinguishing characteristic of urban habitats is the mixture of native and exotic plant species. Exotic plant species may provide valuable habitat elements such as cover for nesting and roosting, as well as food sources such as nuts or berries.

Native and introduced animal species that are tolerant of human activities often thrive in urban habitats. These species include western fence lizard, northern mockingbird, barn swallow (*Hirundo rustica*), raccoon, striped skunk, European starling, house sparrow, house finch, house mouse, Norway rat, and opossum. Special-status species that nest in less disturbed urban habitats include white-tailed kite, Cooper's hawk, and western burrowing owl.

Regional Resource Planning Efforts

The complexity and variability of the topography, geology, and climate in Sonoma and northern Marin counties have contributed to the occurrence of a great diversity of terrestrial biological resources that support a wide variety of plant and animal species. Several large-scale planning efforts which address the protection of this diversity have been undertaken within the Area of Indirect Impacts. A summary of these efforts and applicable guidelines for natural resources protection within the Area of Indirect Impacts is presented in Table 4.8-4.

Table 4.8-4

Summary of Regional Resource Planning Efforts

Jurisdiction	Program Name	Public/Private	Resource Protection Guidelines
California State Coastal Conservancy	Sonoma County Coastal Wetlands Enhancement Plan (March 1987)	Public	Identify, enhance, and protect wetland resources. Reduce erosion and sedimentation Implement the policies of the Sonoma County local coastal program.
California State Coastal Conservancy	San Francisco Bay Joint Venture	Public	Operates under the framework of the North American Waterfowl Management Plan. Protect, restore, and enhance wetlands. Promote cooperative management agreements.
City of Rohnert Park	General Plan (March 14, 1989)	Public	Recognizes the importance of broad matrix of resources of the Laguna de Santa Rosa, and supports the protection, enhancement, and preservation of the Laguna's wetlands and habitat for migratory waterfowl, fish, native plant communities, and endangered plants (Resolution #89-40).
City of Santa Rosa, Sonoma County, Sonoma County Water Agency	Santa Rosa Creek Master Plan (September 21, 1993)	Public	Conserve and restore natural habitats.
Laguna de Santa Rosa Foundation/Coordinated Resources Management Plan	Goals Set for the Laguna de Santa Rosa (Laguna Views, April 1995)	Private	Coordinate resource management. Preserve, restore and enhance native habitats. Accomplish recovery of native species. Assist landowners in conserving and enhancing natural resources. Support the long-term viability of agriculture. Improve integrated floodplain management.

Table 4.8-4

Summary of Regional Resource Planning Efforts

Jurisdiction	Program Name	Public/Private	Resource Protection Guidelines
Marin County Agricultural Land Trust	Mission Statement	Private	No net loss of agricultural land should occur in Marin County.
Marin County and Southern Sonoma Resource Conservation Districts	Stemple Creek/Estero de San Antonio Watershed Enhancement Plan (July 1994)	Public	Assist agricultural producers with practices that promote the conservation and enhancement of natural resources. Encourage environmentally-sound management of rangeland. Investigate the impact of the proposed West County Alternative on agriculture and natural resources. Conserve and enhance existing natural habitats. Restore the riparian corridor.
National Audubon Society (Western Region)	Mayacama Audubon Preserve	Private	Establishment of a preserve for existing resources through acquisition of conservation easements.
San Francisco Bay Conservation and Development Commission	San Francisco Bay Plan (1969)	Public	Protect San Francisco Bay from needless and gradual destruction. BCDC is authorized to issue or deny permits for any filling and dredging in the Bay.
San Francisco Bay Conservation and Development Commission	Guidelines for Enhancement and Restoration of Diked Historic Baylands (February 1983)	Public	Enhance and restore wetlands to create conditions that will be most beneficial to fish and wildlife while avoiding environmental losses and unsuccessful projects.

Table 4.8-4

Summary of Regional Resource Planning Efforts

Jurisdiction	Program Name	Public/Private	Resource Protection Guidelines
San Francisco Bay Conservation and Development Commission, Counties of Marin, Sonoma, Napa, and Solano; Cities of San Rafael, Novato, American Canyon, and Vallejo	North Bay Wetlands Protection Program (Draft due December 1995)	Public	Protect, enhance, and restore North Bay wetlands (allowing uses that are consistent with wetland functions and values, such as agriculture).
San Francisco Bay Estuary Project	Comprehensive Conservation and Management Plan (1993)	Public and Private	Protect and manage existing wetlands. Restore and enhance the ecological productivity and habitat values of wetlands. Expedite a significant increase in the quality and quantity of wetlands. Educate the public about the values of wetland resources
San Francisco Bay Estuary Project	Status and Trends Report on Wetlands and Related Habitats in the San Francisco Estuary (1991)	Public and Private	Protect and manage existing wetlands. Restore and enhance the ecological productivity and habitat values of wetlands. Expedite a significant increase in the quality and quantity of wetlands. Educate the public about the values of wetland resources
San Francisco Bay Regional Water Quality Control Board	Wetlands Ecosystem Goals Project	Public	Develop conceptual options showing optimal mosaic of wetlands and wetland types that the San Francisco Bay-Delta Estuary needs to restore using GIS. Provide a template to guide future wetland restoration projects.

Table 4.8-4

Summary of Regional Resource Planning Efforts

Jurisdiction	Program Name	Public/Private	Resource Protection Guidelines
Santa Rosa Plain Vernal Pool Task Force	Final Santa Rosa Plain Vernal Pool Ecosystem Preservation Plan (June 30, 1995)	Private and Public	Characterize and preserve the full range of diversity of the Santa Rosa Plain vernal pool ecosystem and associated biological resources. Establish goals, policies, and implementation measures for preservation of vernal pool systems and associated biological resources within the vernal pool ecosystem. Help ensure coordinated, effective and timely resolution of conflicts between landowner, agency, and conservation interests. Provide a comprehensive framework for use in linking plant and animal conservation programs with local land use programs. Provide a framework for meeting the requirements of existing federal and state regulatory compliance, including Clean Water Act and federal and state endangered species compliance.
Save San Francisco Bay Association	Partnership for San Pablo Baylands	Private	Educate public on the importance of the San Pablo Baylands. Develop a Baylands Stewardship Plan which would enhance wetland resources and ensure viable agricultural production.

Table 4.8-4

Summary of Regional Resource Planning Efforts

Jurisdiction	Program Name	Public/Private	Resource Protection Guidelines
Sierra Club, Redwood Chapter (Sonoma Group)	Policy on Sonoma County Wastewater Issues	Private	A wastewater system must maximize reclamation and re-use of wastewater as a resource to benefit organic agriculture, and to enhance and promote natural resources and wildlife. All area wastewater reclamation projects must be scaled and diverse enough to allow for redundancy in case of failure. No single system should be selected that could jeopardize people or natural resources in the event of a failure or shutdown. There needs to be adequate contingency plans in place for the initiation of a system to allow for effective shutdown of any one unit or system that becomes non-compliant for any reason.
Sonoma County	Laguna de Santa Rosa Environmental Analysis and Management Plan (May 1977)	Public	Enhance riparian habitat and preserve biotic resources, promote long-term diversity in plant and animal populations.

Table 4.8-4

Summary of Regional Resource Planning Efforts

Jurisdiction	Program Name	Public/Private	Resource Protection Guidelines
Sonoma County Agricultural Preservation and Open Space District	Acquisition Plan Adopted on December 15, 1992 (Revised November 15, 1994)	Public	The Acquisition Plan (in part shall): Evaluate and prioritize within the District's annual Action Plan special areas of interest according to the following criteria (including in part): 1) protection of crucial natural resource areas 2) protection of resources or scenic lands threatened by development or other adverse land use change.
Sonoma County Land Trust	Project Selection Guidelines	Private	Protect open space and natural diversity. Provide permanent protection of land and its resources.
Sonoma County, California State Coastal Conservancy	Russian River Estuary Study (1992-1993 Summary Report); Russian River Estuary Study: Limnological and Biological Aspects of an Estuary Management Plan, 1992-1993 (1993)	Public	Continue implementation of biological monitoring plan: 1) fish and macroinvertebrate sampling 2) test for entrapment of salmonid smoltssmoults 3) continue behavioral observations of pinniped activity 4) mysid shrimp and juvenile fish sampling
Sonoma County, City of Santa Rosa, City of Sebastopol, City of Rohnert Park	Subregional Wastewater Management Plan for the Santa Rosa Plain (1992)	Public	Preserve and enhance fish and wildlife. Protect wildlife and waterfowl from toxic or other deleterious substances.

Table 4.8-4

Summary of Regional Resource Planning Efforts

Jurisdiction	Program Name	Public/Private	Resource Protection Guidelines
U.S. Environmental Protection Agency	North Bay Initiative	Public	Forum for sharing information about wetlands-related planning efforts in the North Bay.
Western Marin County	Marin Coastal Watershed Enhancement Project (November, 1995)	Private	Goals (in part) are to: 1) continue to provide technical assistance and educational information on ranch planning, nutrient budgeting, and wildlife considerations for landowners; 2) assess each watershed to identify and prioritize problems and projects to improve fish habitat; and 3) provide funding to implement critical water quality and conservation projects

Source: Harland Bartholomew & Associates, Inc., 1996

Geographic Area Terrestrial Biological Resources

The Area of Indirect Impacts in Sonoma and Marin counties can be divided into five relatively distinct geographic areas (i.e., Santa Rosa Plain/Russian River, West County, South County, Sebastopol, and geysers) based primarily on watersheds and their associated aquatic and terrestrial biological resources. A brief discussion of the local environment in each geographic area including important local terrestrial biological resources (unique habitats and special-status species) and local resource planning efforts is provided below. Refer to Figures 4.8-1a, 1b, and 1c for a map of each area.

Santa Rosa Plain/Russian River

The Santa Rosa Plain is a flat valley with low gradient watersheds that generally drain in a west-southwest direction into the Laguna de Santa Rosa (CH2M Hill 1995). This area historically supported stands of valley oak woodlands and savannahs interspersed with grasslands. The relatively flat terrain combined with clayey soils and fairly high rainfall contributed to the once widespread occurrence of seasonally inundated areas which are referred to as seasonal wetlands and vernal pools. Human activities, however, have led to a sharp decrease in the abundance and quality of both the oak woodlands and vernal pools. Dairy farming, planting of orchards and vineyards, and conversion of grasslands to pasture have altered the natural vegetation and surrounding landscape (CH2M Hill 1995). These agricultural practices, in conjunction with commercial and residential development, have led to severely fragmented remnants of valley oak woodlands, seasonal wetlands, and vernal pools.

Vernal pools and associated seasonal wetlands are important aquatic plant communities in California. The Santa Rosa Plain contains the best remaining examples of vernal pools and associated seasonal wetlands in the Area of Indirect Impacts. Although these vernal pools are in a semi-natural state, they comprise a unique habitat feature of this geographic area. Other prominent habitat features in this area include the Laguna de Santa Rosa and Russian River. Each of these resources are described in greater detail in the Aquatic Biological Resources, Section 4.9.

West County

The topography of the West County geographic area varies from rolling hills to steep, incised valleys. The area has a strong maritime influence which contributes to the growth of coastal prairie. The gently sloping, wind swept hills of the area also support annual grasslands, while pockets of oak woodland and oak-bay-madrone woodland are found in the steeper valleys. The numerous perennial and intermittent streams of the area contain stands of willow riparian or mixed riparian woodland. Occasionally, narrow seasonal wetlands occur along the banks of these streams and drainages. Many of the valleys and low lying areas also support

seasonal wetlands, freshwater marshes, and vernal pools. Patches of northern coastal scrub are found on the drier hillsides with shallow rocky soils. The West County geographic area also supports a large agricultural community, with the majority of the area being devoted to pasture (for cattle and other livestock) and cropland (primarily oat hay). The predominant exotic plant community is eucalyptus.

The Estero Americano (a component of the Americano Creek watershed) and Estero de San Antonio (a component of the Stemple Creek watershed) comprise unique habitat features of the West County geographic area. Both of the esteros are located within the Gulf of the Farallones National Marine Sanctuary (Sanctuary), with Americano Creek and Stemple Creek emptying into the Sanctuary at the upper ends of the esteros. The aquatic biological resources of the esteros are described in Aquatic Biological Resources, Section 4.9. The esteros are located in the heart of the Pacific Flyway and the mudflats and open water of the esteros provide seasonally important foraging habitat for migratory waterfowl and shorebirds, and resident long-legged wading birds (Connors and Maron 1989, Madrone and Associates 1977). The eelgrass beds located near the mouths of the esteros provide critically important seasonal foraging habitat for migratory brant (*Branta bernicla*), which forage almost exclusively on eelgrass (eelgrass beds are discussed further in Aquatic Biological Resources [Section 4.9]). The Sanctuary is an area of essential foraging habitat for migratory waterfowl, loons, grebes, pelicans, and terns, as well as for resident nesting seabirds such as cormorants, gulls, murres, guillemots, auklets, and puffins (U.S. Fish and Wildlife Service 1981). The importance of the Sanctuary is highlighted by its inclusion as part of the International Biosphere Reserve Network.

The coastline is another unique habitat feature of the West County area and includes coastal bluffs, coastal dunes, coastal scrub, and coastal salt marsh. Special-status plant species associated with these coastal plant communities include pink sand-verbena, Thurber's reedgrass, swamp harebell, Point Reyes bentgrass, Point Reyes bird's-beak, and Point Reyes blennosperma. Golden eagle, double-crested cormorant, western snowy plover, and osprey are special-status animal species that are found in the West County area.

South County (Including Bay Flats)

The South County geographic area supports a large agricultural industry including vineyards, irrigated cropland, and pasture for sheep, cattle, and horses. The northern portion of this area consists of pasture and vineyards on rolling terrain.

Due to the relative inaccessibility to cattle, steeper hillsides within this area support sensitive plant communities including native grasses. Freshwater seeps are also common on many of the hillsides in the area. Riparian and oak woodlands are distributed in areas with well-developed soils along drainages.

Eucalyptus trees are common along fence lines. Although the floodplain of the Petaluma River formerly supported extensive tidal marshes, this area was diked, reclaimed, and is now dominated by cropland and pasture interspersed with seasonal wetlands (including vernal pools) (Association of Bay Area Governments 1991). The remaining tidal marshes are primarily associated with the east side of the Petaluma River.

The Baylands area along northern San Pablo Bay formerly consisted of salt or freshwater marsh wetlands, and are part of the tidal marshes on the north shore of San Pablo Bay. Most of the Baylands area has been drained for agriculture and many of the tidal areas are now surrounded by levees. Channels, agricultural fields, and levees provide the substrate for most of the plant communities found in this area. The channels surround the perimeter of many of the agricultural fields in the Baylands area and are used primarily to convey stormwater during periods of high seasonal runoff. The channels vary from deep (typically up to 10 feet) to shallow and may or may not have emergent vegetation. Seasonally dry areas are found within many of the channels, while standing water may be present within the deeper sections of the channels year-round. Although the Baylands area currently supports primarily crop and pasture land (composed of annual grasses), historic wetlands, farmed wetlands, and wetland pastures are also present (refer to Jurisdictional Wetlands Resources, Section 4.10). The channels and their banks in the southern portion of the Baylands area primarily support salt-tolerant vegetation due to the relatively high salinity of the water. This vegetation typically includes alkali bulrush, alkali heath, pickleweed, and salt grass. The agricultural fields in the Baylands area are primarily composed of common oat, with a few other species present including bird's-foot trefoil, field bindweed, and Italian ryegrass. Stands of eucalyptus and golden wattle (*Acacia longifolia*) surround many of the agricultural fields. Italian ryegrass, ripgut grass, slender wild oat, and wild radish are the major constituents of the levee plant community, with a few scattered coyote brush shrubs also present (Marcus and Velms 1989).

Important habitat features associated with the South County geographic area include the Petaluma Marsh, Cunningham Marsh, Petaluma River, and San Pablo Bay. Three state wildlife areas are located within the vicinity of the South County geographic area and include San Pablo Bay Wildlife Area in Sonoma and Marin counties; Napa-Sonoma Marshes Wildlife Area in Solano, Napa, and Sonoma counties; and the Petaluma Marsh Wildlife Area in Sonoma County. The wildlife areas provide foraging habitat and cover for migratory waterfowl; and cover, breeding, and foraging habitat for resident water birds and other wildlife including special-status species. Special-status species associated with the unique habitat features in the South County geographic area are represented by animals such as San Pablo vole, San Pablo song sparrow, California black rail, California clapper rail, and salt marsh harvest mouse. Examples of special-status plants found in this

area include alkali milk-vetch, Marin western flax, Sonoma spineflower, Marin knotweed, and soft bird's-beak.

Sebastopol

The Sebastopol geographic area is characterized primarily by agricultural plant communities. Orchards consist primarily of apple, crabapple, and peach. Squash and other row crops are also grown in this area. Unirrigated areas are used as pasture and consist of annual grasslands, seasonal wetlands, drainages, and riparian communities. Pitkin Marsh and portions of the Laguna de Santa Rosa are important habitat features found in the Sebastopol geographic area. Special-status plant species known only or primarily from Pitkin Marsh include white sedge, Pitkin Marsh Indian paintbrush, Pitkin Marsh lily, and California beaked-rush. Special-status animal species found in the Sebastopol geographic area include yellow warbler and Cooper's hawk.

Geysers

The geysers geographic area is located at about 1,600 feet in the Mayacamas Mountains of northern Sonoma County. The area is composed of annual and native grasslands, chaparral, and riparian woodland communities. Existing roads and water pipelines built to support the geothermal well fields criss-cross the area.

Serpentinite outcroppings are a unique habitat feature of the geysers geographic area. Special-status plant species associated with this habitat feature include serpentine milkweed, serpentine reed grass, serpentine bird's-beak, tall snapdragon, Calistoga ceanothus, Geysers dichanthelium, Socrates Mine jewel-flower, Freed's jewel-flower, Kruckeberg's jewel-flower, and Three Peaks jewel-flower. Special-status animal species known from the vicinity of the geysers geographic area include golden eagle, peregrine falcon, prairie falcon, purple martin, Cooper's hawk, sharp-shinned hawk, California horned lizard, Bell's sage sparrow, and ringtail (Williamson et al. 1982).

Regulatory Framework

Federal Endangered Species Act

The Federal Endangered Species Act of 1973 (Act) recognized that many species of fish, wildlife, and plants are in danger of or threatened with extinction and established a national policy that all federal agencies should work toward conservation of these species. The Secretary of the Interior and the Secretary of Commerce are designated in the Act as responsible for identifying endangered and threatened species and their critical habitats, carrying out programs for the conservation of these species, and rendering opinions regarding the impact of proposed federal actions on endangered species. The Act also outlines what

constitutes unlawful taking, importation, sale, and possession of endangered species and specifies civil and criminal penalties for unlawful activities.

Biological assessments are required under Section 7(c) of the Act if listed species or critical habitat may be present in the area affected by any major construction activity as defined in Part 404.02. Under Section 7(a)(3) of the Act every federal agency is required to consult with the United States Fish and Wildlife Service or National Marine Fisheries Service on a proposed action if the agency has reason to believe that an endangered or threatened species may be present in an area affected by the proposed action and that implementation of the action will likely affect the species.

National Environmental Policy Act

Pursuant to the U.S. Council on Environmental Quality Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act, the significance of an impact on the quality of the human environment is determined by considering the context in which it will occur and the intensity of the action (40 CFR, Part 1508, Section 1508.27). "Context" refers to the affected region and the locality in which the action would occur; significance, therefore, will vary depending on the setting of the proposed action. "Intensity" refers to the severity of the impact. In determining the intensity of an impact to wildlife, the following factors should be considered:

> Unique Characteristics: An action which affects unique characteristics of the geographic area, such as ecologically critical areas, could be considered to have a significant impact on the human environment.
>
> Threatened/Endangered Species: An action which adversely affects an endangered or threatened species or its habitat could be considered to have a significant impact on the human environment.

National Oceanic and Atmospheric Administration

The National Oceanic and Atmospheric Administration (NOAA) has regulatory authority over the Gulf of the Farallones National Marine Sanctuary. This sanctuary was designated under Section 302(a) of Title III of the Marine Protection, Research and Sanctuaries Act of 1972. The sanctuary encompasses an area of the waters adjacent to the coast of California north and south of the Point Reyes Headlands, between Bodega Head and Rocky Point and the Farallon Islands (including Noonday Rocks).

California Environmental Quality Act

CEQA Guidelines - Article 5, Section 15065

Article 5, Section 15065 of the CEQA Guidelines requires that a lead agency make mandatory findings of significance in an EIR if:

> "The Project has the potential to substantially degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal, or eliminate important examples of the major periods of California history or prehistory."

CEQA Guidelines - Section 15380

Rare or endangered species are defined in the CEQA Guidelines (Section 15380) as follows:

(a) "Species" as used in this section means a species or subspecies of animal or plant or variety of plant.

(b) A species of animal or plant is:

(1) "Endangered" when its survival and reproduction in the wild are in immediate jeopardy from one or more causes, including loss of habitat, change in habitat, overexploitation, predation, competition, disease, or other factors; or

(2) "Rare" when either:

(A) Although not presently threatened with extinction, the species is existing in such small numbers throughout all or a significant portion of its range that it may become endangered if its environment worsens; or

(B) The species is likely to become endangered within the foreseeable future throughout all or a significant portion of its range and may be considered "threatened" as that term is used in the Federal Endangered Species Act.

(c) A species of animal or plant shall be presumed to be rare or endangered as it is listed in:

(1) Sections 670.2 or 670.5, Title 14, California Administrative Code; or

(2) Title 50, Code of Federal Regulations Sections 17.11 or 17.12 pursuant to the Federal Endangered Species Act as rare, threatened, or endangered.

(d) A species not included in any listing identified in subsection (c) shall nevertheless be considered to be rare or endangered if the species can be shown to meet the criteria in subsection (b).

CEQA Guidelines - Appendix G

Appendix G of the State CEQA Guidelines lists several impacts that are "normally" considered significant. The three impacts relating to biological resources are listed below:

1. Substantially affect a rare or endangered species of animal or plant or the habitat of the species;

2. Interfere substantially with the movement of any resident or migratory fish or wildlife species; and

3. Substantially diminish habitat for fish, wildlife, or plants.

California Endangered Species Act

The California Endangered Species Act (Fish and Game Code Sections 2050-2098) established a State policy to conserve, protect, restore, and enhance any endangered species or any threatened species and its habitat. The Fish and Game Commission is charged with establishing a list of endangered and threatened species. State agencies must consult with the Department of Fish and Game to determine if a proposed Project is likely to jeopardize the continued existence of any endangered or threatened species.

Section 2081 of the Fish and Game Code allows the "take" of a species listed as threatened or endangered by the California Endangered Species Act. Take is defined as any act that involves direct mortality or other actions that may result in adverse impacts when attempting to take individuals of a listed species. Under Section 2081, the state Department of Fish and Game may issue a memorandum of understanding to authorize take for scientific, educational or management purposes only. Private development that may adversely affect a listed species is prohibited from any take of a species unless the sponsor obtains a Management Authorization for the development Project pursuant to Section 2081. The applicant must agree to strict measures and standards for the management of the species and sign a Memorandum of Understanding to carry out these measures.

California Fish and Game Code

Native Plant Protection Policy

The goals of the California Native Plant Protection Policy are as follows:

The intent of the Legislature and the purpose of this chapter is to preserve, protect, and enhance endangered or rare plants of this state (Section 1900). For purposes of this Chapter, a 'native plant' means a plant that grows in a wild uncultivated state which is normally found native to the plant life of this state (Section 1901).

The commission may adopt regulations governing the taking, possession, propagation, transportation, exportation, importation, or sale of any endangered or rare native plants. Such regulations may include, but shall not be limited to, requirements for persons who perform any of the foregoing activities to maintain written records and to obtain permits which may be issued by the department (Section 1907).

No person shall import into this state, or take, possess, or sell within this state, except as incident to the possession or sale of the real property on which the plant is growing, any native plant, or any part or product thereof, that the commission determines to be an endangered native plant or a rare native plant, except as otherwise provided in this chapter (Section 1908).

All state departments and agencies shall, in consultation with the department, utilize their authority in furtherance of the purposes of this chapter by carrying out programs for the conservation of endangered or rare native plants. Such programs include, but are not limited to, the identification, delineation, and protection of habitat critical to the continued survival of endangered or rare native plants (Section 1911).

Biological Resource Goals, Objectives, and Policies

Table 4.8-5 identifies goals, objectives, and policies which provide guidance for development in relation to biological resources (terrestrial, aquatic and wetlands) in the Project area. The table also indicates which criteria in the Terrestrial Biological Resources, Aquatic Biological Resources, and Jurisdictional Wetlands Resources Sections are responsive to each set of policies.

Table 4.8-5

General Plan Goals, Objectives, and Policies - Biological Resources

Adopted Plan Document	Document Section	Document Numeric Reference	Policy	Relevant Evaluation Criteria[1]
Sonoma County General Plan	Land Use Element	Goal LU-9 Objective LU-9.1	Accomplish development on lands with important biotic resources and scenic features in a manner which preserves or enhances these features	4.8.1-7 4.9.1-9 4.10.1
Sonoma County General Plan	Resource Conservation Element	Goal RC-5 Objective RC-5.1	Promote and maintain the County's diverse plant and animal communities and protect biotic resources from development activities, including areas with important wildlife habitats and woodland resources	4.8.1-7 4.9.1-9 4.10.1
Sonoma County General Plan	Recource Conservation Element	Objective RC-5.3	Recognize and preserve the Laguna de Santa Rosa and the San Pablo Bay area as biotic resource areas of particular significance to Sonoma County's environment	4.8.1-7 4.9.4,5,7,8 4.10.1
Sonoma County General Plan	Recource Conservation Element	Goal RC-6 Objective RC-6.1 Objective RC-6.2	Identify and protect rare and endangered species and their environment and require that any development on lands containing rare and endangered species be done in a manner which protects the resource or mitigates adverse impacts	4.8.1 4.9.1 4.10.1
Sonoma County General Plan	Recource Conservation Element	Goal RC-7	Protect and conserve the quality of ocean, marine, and estuarine environments for environmental values	4.9.6
Sonoma County General Plan	Recource Conservation Element	Goal RC-8 Objective RC-8.1	Encourage effective management of freshwater fishery resources, balance competing needs with protection of the stream environment and manage riparian corridors along streams to provide protection for fish habitat.	4.9.5,7,8,9

Table 4.8-5

General Plan Goals, Objectives, and Policies - Biological Resources

Adopted Plan Document	Document Section	Document Numeric Reference	Policy	Relevant Evaluation Criteria[1]
Sonoma County General Plan	Open Space Element	Goal OS-4 Objective OS-4.1 Objective OS-4.2	Identify critical habitat areas and assure that the quality of these natural resources is maintained and not adversely affected by development activities	4.8.1-7 4.9.1-9 4.10.1
Sonoma County General Plan	Open Space Element	Policy OS-4e	Require a minimum setback of 50 feet from the edge of any wetlands which are within a critical habitat area	4.10.1
Sonoma County General Plan	Open Space Element	Goal OS-5 Objective OS-5.1	Provide protective measures for riparian corridors along selected streams which balance other needs with preservation of riparian values	4.8.1-7 4.9.1-9
Sonoma County General Plan	Open Space Element	Policy OS-5c Policy OS-5e	Establish streamside conservation areas for designated riparian corridors as follows: Urban: 50 feet Russian River: 200 feet Flatland: 100 feet Upland: 50 feet Allow grazing and similar agricultural production activities not involving structures within any streamside conservation area: except that agricultural cultivation shall be no closer than: Russian River corridors: 100 feet from top of bank Flatland corridors: 50 feet from top of bank Upland corridors: 25 feet from top of bank	4.8.1-7

Table 4.8-5

General Plan Goals, Objectives, and Policies - Biological Resources

Adopted Plan Document	Document Section	Document Numeric Reference	Policy	Relevant Evaluation Criteria[1]
Sonoma County General Plan	Open Space Element	Policy OS-5h	Roadway and utility construction should seek to minimize and mitigate, where feasible, damage to riparian areas, and minimize vegetation removal for necessary stream crossings	4.8.1-7 4.9.1-9
Marin Countywide Plan	Environmental Quality Element	Policy EQ-2.1 Policy EQ-2.2 Policy EQ-2.3	Riparian systems, streams and their woodland habitat should be protected as essential environmental resources and a Stream Conservation Area (SCA) should be designated along all natural watercourses shown as blue line streams or dashed blue lines on the most recent appropriate USGS quad sheets, or along all watercourses supporting riparian vegetation for a length of 100 feet or more. These should be subject to stream and creekside protection policies and in the Inland Rural Corridor, the zone should extend 50 feet landward from the edge of the riparian vegetation	4.8.1-7 4.9.1-9
Marin Countywide Plan	Environmental Quality Element	Policy EQ-2.43c	No overall net losses shall occur in wetlands acreage, functions and values	4.10.1
Marin Countywide Plan	Environmental Quality Element	Policy EQ-2.59	Agricultural activities should minimize removal of natural vegetation and avoid removal of wetland vegetation, where possible	4.8.1-7 4.9.4 4.10.1

Table 4.8-5

General Plan Goals, Objectives, and Policies - Biological Resources

Adopted Plan Document	Document Section	Document Numeric Reference	Policy	Relevant Evaluation Criteria[1]
Marin Countywide Plan	Environmental Quality Element	Policy EQ-2.85	Consider the impact of proposed development on species and habitat diversity	4.8.1-7 4.9.1-9 4.10.1
Marin Countywide Plan	Environmental Quality Element	Policy EQ-2.86	Development shall be restricted or modified in areas which contain special status and migratory species of the Pacific Flyway and/or significant natural areas, wetlands, riparian habitats, and freshwater habitats, to ensure the continued health and survival of these species and areas	4.8.1-7 4.9.1-9 4.10.1
Marin Countywide Plan	Environmental Quality Element	Policy EQ-3.4	No operation shall cause irreversible damage or more than minimum reversible change to natural biological processes	4.8.1-7 4.9.1-9 4.10.1
Marin Countywide Plan	Environmental Quality Element	Policy EQ-3.6	Diversity and abundance of wildlife and marine life shall be maintained, and vegetation and animal habitats shall be preserved wherever possible	4.8.1-7 4.9.1-9 4.10.1
Marin Countywide Plan	Environmental Quality Element	Policy EQ-3.14	Protect large trees, trees with historical importance, and oak woodland habitat, and prevent the untimely removal of trees through implementation of a tree preservation ordinance	4.8.5
Marin Countywide Plan	Environmental Quality Element	Policy EQ-3.20	Along creeks, development must retain natural vegetation	4.8.5
Marin Countywide Plan	Environmental Quality Element	Policy EQ-3.26	Development shall be situated so that wetlands are protected and preserved to the maximum extent feasible	JW1

Table 4.8-5

General Plan Goals, Objectives, and Policies - Biological Resources

Adopted Plan Document	Document Section	Document Numeric Reference	Policy	Relevant Evaluation Criteria[1]
Santa Rosa General Plan	Element	Goal OSC-1	Preserve and restore the natural network of creeks and creek habitats	4.8.1-7 4.9.1-9
Santa Rosa General Plan	Element	Goal OSC-2	Identify and preserve vernal pool wetlands and restore modified pools	4.10.1
Santa Rosa General Plan	Element	Goal OSC-3	Conserve significant trees and vegetation in Santa Rosa, including creek corridors and hillsides, in rural and agricultural areas, and in urban areas	4.8.5
Santa Rosa General Plan	Element	Goal OSC-4	Conserve the habitats and movement corridors required by wildlife	4.8.1,6
Santa Rosa General Plan	Element	Goal LUR-3	Conserve biotic values of the City's hillsides, ridgelines, outlying valleys, and drainage courses	4.8.1-7 4.9.1-9
Petaluma General Plan	Community Character Element	Objective (l) Policy 18	Preserve heritage and landmark trees and major groves.	4.8.5
Petaluma General Plan	Petaluma River Element	Goal 2 Objective (i) Objective (j)	Preserve and protect the Petaluma River and streams in their natural state as open spaces, natural resources and habitats	4.8.1-7 4.9.1-9
Petaluma General Plan	Open Space, Conservation and Energy Element	Objective (m) Objective (o)	Protect water resources important to the area's ecology, including the Petaluma Marsh	4.9.1-9 4.10.1
Petaluma General Plan	Open Space, Conservation and Energy Element	Objective (n)	Enhance the wildlife habitat and maintain wildlife travel corridors along waterways	4.8.1,6

Table 4.8-5

General Plan Goals, Objectives, and Policies - Biological Resources

Adopted Plan Document	Document Section	Document Numeric Reference	Policy	Relevant Evaluation Criteria[1]
Petaluma General Plan	Open Space, Conservation and Energy Element	Objective (q) Objective (r)	Stabilize banks of waterways and establish a continuous strip of native vegetation	4.8.4,5,6
Petaluma General Plan	Open Space, Conservation and Energy Element	Objective (s)	Manage waterways in the Petaluma Planning Referral Area to ensure compatibility between wildlife, plant restoration, and agriculture	4.8.1-7 4.9.1-9
Sebastopol General Plan	Conservation, Parks, and Open Space Element	Goal 1 Program 4.1 Program 6	Preserve and protect environmentally sensitive areas and areas with important biotic resources such as wetlands, upland habitat, endangered plant and other biotic resources	4.8.1-7 4.9.1-5, 7-9 4.10.1
Sebastopol General Plan	Conservation, Parks, and Open Space Element	Goal 2 Goal 3	Protect, maintain, and restore wetlands	4.10.1
Sebastopol General Plan	Conservation, Parks, and Open Space Element	Goal 5 Program 13	Conserve, protect, and enhance trees and native vegetation	4.8.5
Sebastopol General Plan	Conservation, Parks, and Open Space Element	Goal 14 Program 44 Program 44.2	Protect and enhance existing sensitive habitats in the Laguna, and provide buffer areas to avoid or minimize potential adverse ecological effects and for farm management	4.8.1-7 4.9.1-5, 7-9
Windsor General Plan	Environmental Resources Element	Policy D1.1	Significant biological and ecological resources in the Windsor Planning Area should be protected, including wetlands; rare, threatened and endangered species and their habitats; vernal pools; heritage trees; and oak and riparian woodlands	4.8.1-7 4.9.1 4.10.1

Table 4.8-5

General Plan Goals, Objectives, and Policies - Biological Resources

Adopted Plan Document	Document Section	Document Numeric Reference	Policy	Relevant Evaluation Criteria[1]
Windsor General Plan	Environmental Resources Element	Policy D1.3	Development Projects which would fill wetlands or vernal pools shall be required to conform with applicable state and federal regulations	4.10.1
Windsor General Plan	Environmental Resources Element	Policy D.1.6	Preserve oak woodlands and significant stands of oaks and heritage trees, and require proper measures to assure their long-term survival	4.8.5

Source: Harland Bartholomew and Associates, Inc., 1995

Notes:
1 Criteria are described as follows:
Terrestrial Biological criteria in Table 4.8-9
Aquatic Biological criteria in Table 4.9-7
Jurisdictional Wetlands criteria in Table 4.10-2

EVALUATION CRITERIA WITH POINTS OF SIGNIFICANCE

Table 4.8-6 summarizes both the evaluation criteria and point of significance used to address potential impacts to terrestrial biological resources.

The California Fish and Game Code, NEPA, CEQA, the Federal Endangered Species Act, and the California Endangered Species Act were used as supporting documentation in developing the evaluation criteria and points of significance. In addition, pertinent policies and data bases from the California Department of Fish and Game, United States Fish and Wildlife Service, and the National Oceanic and Atmospheric Administration were also considered. Policies adopted by local private organization such as the Sierra Club - Sonoma Chapter, Marin and Sonoma Resource Conservation Leagues, Sonoma Land Trust, and the Marin Land Trust were also evaluated.

Table 4.8-6

Evaluation Criteria and Point of Significance - Terrestrial Biological Resources

Evaluation Criteria	As Measured By	Point of Significance	Justification
1. Will the Project cause loss of individuals or occupied habitat of endangered, threatened, or rare terrestrial wildlife or plant species[1]?	a. Number of individuals of a plant or wildlife species that would be lost b. Acres of occupied or designated critical habitat	a. Greater than 0 individuals b. Greater than 0 acres	FESA, CESA (Sections 2062 and 2067), CEQA (Article 5, Section 15065), and California Native Plant Protection Act (CDFG Code Sections 1900-1913)
2. Will the Project cause loss of individuals of CNPS List 2, 3, or 4 terrestrial plant species?	Number of plant species or populations that would experience a loss of individuals	Greater than 15 percent of known occurrences or populations in Sonoma and Marin counties	California Native Plant Protection Act (CDFG Code Sections 1900-1913), CEQA (Article 5, Section 15065)
3. Will the Project cause loss of active raptor nest sites?	Number of active nesting sites	Greater than 0 active nest sites	CEQA (Article 5, Section 15065), CDFG Wildlife Habitat Relationships model - (Version 5.2), Fish and Game Code - (Section 3503.5)
4. Will the Project cause permanent loss of sensitive terrestrial wildlife habitat[2]?	Acres of sensitive terrestrial wildlife habitat	Greater than 25 percent of each habitat type	CEQA (Article 5, Section 15065), CDFG Wildlife Habitat Relationships model - (Version 5.2)
5. Will the Project cause permanent loss of sensitive native terrestrial plant communities?	Acres of sensitive native terrestrial plant community lost	Greater than 0 acres	CEQA (Article 5, Section 15065), California Native Plant Protection Act (Fish and Game Code, Sections 1900-1913), CDFG Interim Wildlife/Hardwood Management Guidelines (February 1, 1989), CDFG (CNDDB 1994, 1995), Sonoma County Tree Ordinance 4014 (June 13, 1989)

Table 4.8-6

Evaluation Criteria and Point of Significance - Terrestrial Biological Resources

Evaluation Criteria	As Measured By	Point of Significance	Justification
6. Will the Project substantially block or disrupt major terrestrial wildlife migration or travel corridors?	Number of corridors substantially blocked or disrupted	Greater than 0 corridors	CEQA (Appendix G)
7. Will the Project may result in ecological risk to terrestrial plant and wildlife populations (i.e., acute or chronic toxicity and bioaccumulation)?	Ecological Quotient (EQ)[3]	EQ greater than 10	Menzie et al. 1993

Source: Harland Bartholomew & Associates, Inc., 1996

Notes:

CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CNDDB	California Natural Diversity Data Base
CNPS	California Native Plant Society
FESA	Federal Endangered Species Act
USFWS	United States Fish and Wildlife Service

1. Endangered, threatened, or rare is defined here as:
   - federally listed endangered, threatened, or proposed plant or wildlife species
   - state listed endangered, threatened, or proposed plant or wildlife species or rare plant species
   - federal candidates for listing
   - CNPS List 1B plant species
2. Sensitive terrestrial wildlife are defined here as:
   - wildlife designated as "species of special concern" by the California Department of Fish and Game
   - wildlife listed as "fully protected" in California
3. Ecological quotient is the ratio of the exposure concentration or exposure rate to the appropriate benchmark value (i.e., reference values for potential effects on site organisms).

METHODOLOGY

The following section provides a brief discussion of the survey and analytical methodologies utilized in assessing terrestrial biological resource impacts within the Area of Directs Impacts and Area of Indirect Impacts.

Terrestrial biological resources potentially impacted by Project alternatives were identified through literature review, California Natural Diversity Data Base (CNDDB) record searches, consultation with natural resource experts, and field surveys. The CNDDB contains occurrence records for special-status plant and animal species, as well as sensitive natural vegetation communities. CNDDB record searches were conducted in 1994 and 1995 for each 7.5 minute USGS quadrangle that contains portions of the Area of Indirect Impacts. In addition, resource agency representatives (California Department of Fish and Game, United States Fish and Wildlife Services, National Marine Fisheries Service) and local natural resources experts (e.g., Milo Baker Chapter of the California

Native Plant Society, and the Madrone Chapter of the National Audubon Society) were consulted to provide available occurrence data not provided by the CNDDB.

Field surveys were conducted at each Project alternative component site in order to describe, inventory, and map the existing terrestrial biological resources. The results of CNDDB record searches, field observations, and field mapping of terrestrial biological resources were entered into a Geographic Information System (GIS) data base as separate layers (e.g., wetlands, vegetation communities, wildlife habitats, and special-status species occurrences). The GIS database was queried to determine the acreage and location of vegetation communities, wetlands, wildlife habitats, and number and location of special-status species occurrences within the construction zone boundary of each component site. The data were then used to evaluate impacts by comparison to the impact evaluation criteria in Table 4.8-6. For a more thorough discussion of analytical methods refer to the *Biological Resources Technical Memorandum, Volume 1* (Harland Bartholomew & Associates, Inc. 1996a). Survey methodologies specific to terrestrial biological resources are briefly summarized below.

Pipeline Routes, Pump Stations, and Downstream Studies

Single reconnaissance-level pedestrian surveys for terrestrial biological resources were conducted along all pipeline routes, at pump station sites, and along streams located downstream of the storage reservoir sites. All surveys of the pipeline routes were conducted within road right-of-ways, while the surveys of downstream drainages were only conducted on accessible parcels. Each of the above surveys was conducted from June through October, 1995.

The pipeline routes were again assessed, in late February 1996, from a vehicle to determine plant communities and wildlife habitats that were present within the pipeline construction zone. All plant communities and wildlife habitat types (except for annual grassland, cropland, pasture, and urban) located within 30 feet of the road were mapped as a point occurrence. Annual grassland, community point occurrences was not mapped because of the disturbed nature of this community within road right-of-ways and limited nature of potential impacts. This point occurrence referred to an approximate width and extent (perpendicular extension from road) of each of the vegetative communities observed.

When possible, private property associated with cross-country pipelines was assessed from an off-site location in a public right-of-way. The geysers steamfield distribution line routes were assessed on foot because there were no adjacent roads.

Storage Reservoir Sites

Terrestrial biological resource surveys were conducted at each proposed storage reservoir site. Surveys were conducted within the area encompassed by the construction zone boundary.

Plant Surveys

Special-status plant surveys were conducted by botanists, utilizing a four-visit approach at each of the reservoir sites. The four visits occurred during the early spring (late February to mid-March 1995), mid-spring (May 1995), summer (June 1994 and 1995), and late summer/early fall (mid-September 1994 and mid-August 1995). Botanical surveys during each of the four visits were conducted in accordance with the "Guidelines Assessing Effects of Proposed Developments on Rare and Endangered Plants and Plant Communities" (Skinner and Pavlik 1994). Botanists walked meandering transects to allow for 100 percent visual coverage of each reservoir site. The botanists, while concentrating on special-status plant species, also developed a complete plant inventory for each reservoir site. Refer to the *Biological Resources Technical Memorandum*, *Volume 3*, Appendix A for complete plant inventories (Sycamore Environmental Consultants, Inc. 1996).

Plant Community Mapping

Plant communities within the reservoir construction zones were mapped using 1994 aerial photographs at a scale of 1"=500'. The mapped aerial photographs were ground-truthed to verify plant community identification and boundaries.

California Wildlife Habitat Relationships Mapping

The California Wildlife Habitat Relationships System was used as a primary tool for the impact evaluation on terrestrial biological resources. The Wildlife Habitat Relationships System was developed by a consortium of state agencies and private organizations and is maintained by the California Department of Fish and Game. The system includes comprehensive information for California wildlife that describes and models, habitat relationships and requirements, geographic distribution, life history, and responses to habitat changes of wildlife species in the system. Currently, the system has models for 646 species of regularly occurring resident and migratory terrestrial and aquatic amphibians, reptiles, birds, and mammals in California. Only regularly occurring species are included in the Wildlife Habitat Relationship System since they are the species that typically receive management emphasis by resource professionals in California.

Wildlife habitat mapping consisted of field inventories for wildlife habitats and wildlife habitat elements on all storage sites. Botanists utilized the point-center vegetation sampling method for identifying the habitat type and determining the seral stage and percent cover. The point-center method involved dropping a thin dowel perpendicular to the ground at one-meter intervals along a 50 meter transect and characterizing any vegetation or habitat component touched by the dowel. At least two randomly-placed transects were sampled in each 40 acres of representative habitat. Wildlife biologists also recorded habitat elements present near the transect. Habitat elements are specific physical and biological attributes

of the surrounding landscape (e.g., ponds and rock formations) which are essential to the life history of a wildlife species.

The Wildlife Habitat Relationship analysis predicts wildlife species occurrences within given habitat types. Habitat types are rated for their potential (low, moderate, or high) to provide reproductive, cover, and feeding requirements for each wildlife species (Mayer and Laudenslayer 1988). Based on the model's output, habitat was evaluated for its potential to support special-status wildlife species that were deemed likely to occur within the construction zone of the reservoir sites. Wildlife habitat types that were rated high for reproduction, cover, or feeding for a particular special-status wildlife species were evaluated in the impact analysis. Refer to the *Biological Resources Technical Memorandum, Volume 1* for a more detailed description of the Wildlife Habitat Relationship system and habitat types (Harland Bartholomew & Associates, Inc. 1996a).

Wildlife Surveys

Riparian bird surveys were conducted on all reservoir sites where access was permitted, in the spring of 1994 and 1995 (i.e., mid-April to mid-June). Biologists walked meandering transects along all riparian corridors within a given reservoir site in order to obtain one hundred percent visual coverage. Binoculars were used for visual identification, and auditory identification of songs and calls was also used to identify all bird species encountered. All species identified during the riparian bird surveys were recorded on standardized field forms.

Burrowing owl habitat assessments were conducted concurrently with other focused surveys, such as riparian bird surveys and sampling transects. The burrowing owl habitat assessments consisted of searching for the presence of ground squirrel colonies and suitable nearby foraging habitat (i.e., primarily short to medium height grassland, pasture, or fallow agricultural fields).

In addition, biologists also recorded the wildlife species observed incidentally during other focused surveys on standardized field forms. The results of all focused wildlife surveys conducted on storage reservoir sites are summarized and presented in the *Biological Resources Technical Memorandum, Volume I* (Harland Bartholomew & Associates, Inc. 1996a).

Agricultural Irrigation Areas

Surveys to assess the terrestrial biological resources located within the agricultural irrigation areas were conducted from August through October 1995. A general approach to these surveys was established through consultation with the California Department of Fish and Game, U.S. Fish and Wildlife Service and the U.S. Army Corps of Engineers. Because access to private property was not always granted, on-site surveys of some parcels located within agricultural irrigation areas could not be conducted. These parcels

were assessed from adjacent public right-of-ways when possible. Due to the vast acreage associated with each of the agricultural irrigation areas, multiple visits to each area did not occur. A more detailed description of each specific survey effort is provided below.

Plant Surveys

Plant surveys were conducted on all agricultural irrigation areas that were accessible. All observations of special-status plant species were recorded and mapped.

Plant Community Mapping

Plant communities within the agricultural irrigation areas were identified and mapped (see storage reservoir methodology for further details concerning accessible areas). The plant communities of inaccessible areas were mapped on aerial photographs (1"=500', 1990) and ground-truthed from adjacent public rights-of-way.

Wildlife Surveys

No focused wildlife surveys were conducted at the proposed agricultural irrigation areas. However, observations of special-status species were recorded and mapped on areas that were accessible. All observed wildlife species and wildlife species sign were recorded on standardized field forms.

California Wildlife Habitat Relationships Mapping

Wildlife habitats (Mayer and Laudenslayer 1988) within the agricultural irrigation areas were identified and mapped (see storage reservoir methodology for further details concerning accessible areas). Visible habitat elements were recorded on standardized field forms. The wildlife habitats of inaccessible areas were mapped on aerial photographs (1"=500', 1990) and ground-truthed from adjacent public rights-of-way.

Ecological Risk Assessment

An ecological risk assessment of representative sites under the various Project alternatives was undertaken to evaluate potential adverse effects to ecological resources as a result of the increased discharge of treated wastewater. The primary objective of the ecological risk assessment was to identify and characterize the potential risks posed to environmental receptors (i.e., individual species) as a result of the alternative wastewater releases. The assessment was also used for the overall characterization of the various areas potentially affected and as the basis for evaluating each of the discharge alternatives under consideration.

Two main routes of exposure were identified for evaluation of ecological risk to terrestrial and aquatic organisms due to the implementation of the Project: direct contact with the media (surface soil, water, and sediment) and indirect exposure by dietary intake. Specific ecological receptors were selected to evaluate potential effects on aquatic biota and wildlife exposure through food ingestion. Key ecological receptors (i.e., target species), representative of various trophic levels were evaluated, including mallard duck, red-tailed hawk, and great blue heron.

In the evaluation of potential effects on terrestrial wildlife, benchmarks were based on toxicological data for individual test species. These screening benchmarks identify soil concentrations which have a low potential for effects on biota, based on toxicological data for several test species. Benchmarks for evaluation of potential effects of chemicals on terrestrial vegetation and soil invertebrates were obtained from various sources including screening reference values developed by the Oak Ridge National Laboratory.

The assessment of ecological risk was based on the calculation of the ecological quotients (EQs). The quotient is calculated as the ratio between exposure concentration for a given chemical substance and an applicable benchmark value that identifies possible adverse effect levels on ecological receptors. The characterization of potential effects on receptor organisms was based on the following guidelines (EPA 1989; Watkins and Stelljes 1993; Menzie et al., 1993) These are standard accepted parameters for risk assessment evaluation, and provide a protective level of significance:

- Adverse effects are not expected for EQ values equal to, or less than, 1;
- A low potential for environmental effects is indicated by an EQ value between 1 and 10;
- A significant potential for adverse effects is indicated by an EQ value greater than 10; and
- EQs in excess of 100 identify a very high probability for potential adverse effects on ecological receptors and biological communities.

Six major pathways were identified for the potential exposure of aquatic organisms and wildlife to the reclaimed water: 1) direct exposure to the reclaimed water in Santa Rosa Creek and the Laguna de Santa Rosa (including fish consumption by the great blue heron); 2) exposure of organisms associated with the Russian River (including fish consumption by the harbor seal); 3) exposure of rooted vegetation, benthic organisms, and waterfowl to sediments in the Laguna de Santa Rosa and the Russian River; 4) exposure of aquatic and terrestrial vegetation by reclaimed water application to irrigation fields; and 6) potential releases from reclaimed water pipelines along the transfer route to the geysers injection area. Exposure through river discharge was estimated at 1 percent, 5 percent, 10 percent, and 20 percent discharge rates. Detail on the risk assessment

methodology and results is presented in the *Ecological Risk Assessment* (Parsons Engineering Science, Inc. 1996).

ENVIRONMENTAL CONSEQUENCES (IMPACTS) AND RECOMMENDED MITIGATION

No Action (No Project) Alternative

Table 4.8-7

Terrestrial Biological Resources Impacts by Component - No Action Alternative

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
8.1.1. Will the No Action Alternative cause loss of individuals or occupied habitat of endangered, threatened, or rare terrestrial wildlife or plant species?	a. Greater than 0 individuals b. Greater than 0 acres	None	C	=
8.1.2. Will the No Action Alternative cause loss of individuals of CNPS List 2, 3, or 4 terrestrial plant species?	Greater than 15 percent of known occurrences or populations in Sonoma County	None	C	=
8.1.3. Will the No Action Alternative cause loss of active raptor nest sites?	Greater than 0 active nest sites	None	C	=
8.1.4. Will the No Action Alternative permanent loss of sensitive terrestrial wildlife habitat?	Greater than 25 percent of each habitat type in Sonoma County	None	C	=
8.1.5. Will the No Action Alternative cause permanent loss of sensitive native terrestrial plant communities?	Greater than 0 acres	None	C	=
8.1.6. Will the No Action Alternative substantially block or disrupt major terrestrial wildlife migration or travel corridors?	Greater than 0 corridors	None	C	=

Table 4.8-7

Terrestrial Biological Resources Impacts by Component - No Action Alternative

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
8.1.7. Will the No Action Alternative result in ecological risk to terrestrial plant and wildlife populations (i.e., acute or chronic toxicity and bioaccumulation)?	Ecological Quotient (EQ) greater than 10	EQ less than 8.02	O&M	○

Source: Harland Bartholomew & Associates, Inc., 1996

Notes: 1. Type of Impact:
C Construction
O&M Operation and Maintenance

2. Level of Significance:
○ Less than significant impact; no mitigation proposed
= No impact

Impact: **8.1.1-6. Will the No Action Alternative impact terrestrial biological resources based on evaluation criteria 1 through 6?**

Analysis: *No Impact; Alternative 1.*

The No Action Alternative involves no construction and therefore no construction impacts will result.

Mitigation: No mitigation is needed.

Impact: **8.1.7. Will the No Action Alternative result in ecological risk to terrestrial plant and wildlife populations (i.e., acute or chronic toxicity and bioaccumulation)?**

Analysis: *Less than Significant; Alternative 1.*

Continued discharge of reclaimed water to the Russian River through the Laguna will result in low risks to terrestrial wildlife from ingestion of aquatic organisms (EQ is between 0.0 and 0.38) or ingesting fish from the Laguna (EQ less that 8.02). These risks are less than the point of significance (EQ greater than 10), therefore this impact is less than significant. Impacts to harbor seals in the Russian River is included in the Aquatic Biological Resources section.

Mitigation: No mitigation is proposed.

Headworks Expansion Component

Impact: **8.2.1-7. Will the headworks expansion component impact terrestrial biological resources based on evaluation criteria 1 through 7?**

Analysis: *No Impact; All Alternatives.*

The headworks expansion will not require additional land and as a consequence no new surface impacts are expected to occur. There will be no impact to terrestrial biological resources associated with the headworks expansion.

Alternative 1 does not have a headworks expansion component.

Mitigation: No mitigation is needed.

Urban Irrigation Component

Impact: **8.3.1-7. Will the urban irrigation component impact terrestrial biological resources based on evaluation criteria 1 through 7?**

Analysis: *No Impact; All Alternatives.*

The rate of application of irrigation water and the irrigated acreage at the urban irrigation sites will remain the same. The only change will be associated with the source of the irrigation water. Currently, these sites are supplied with water from wells and city water. The Project will provide for the use of reclaimed water. Since both the rate of application and the area irrigated will not change as a result of this Project, there will be no impacts to terrestrial biological resources.

Alternatives 1, 4, and 5 do not have an urban irrigation component.

Mitigation: No mitigation is needed.

Pipeline Component

Table 4.8-8

Terrestrial Biological Resources Impacts by Component - Pipelines

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
8.4.1. Will the pipeline component cause loss of individuals or occupied habitat of endangered, threatened, or rare terrestrial wildlife or plant species?	a. Greater than 0 individuals b. Greater than 0 acres	None	C	=
8.4.2. Will the pipeline component cause loss of individuals of CNPS List 2, 3, or 4 terrestrial plant species?	Greater than 15 percent of known occurrences or populations in Sonoma County	None	C	=
8.4.3. Will the pipeline component cause loss of active raptor nest sites?	Greater than 0 active nest sites	None	C	=
8.4.4. Will the pipeline component cause permanent loss of sensitive terrestrial wildlife habitat?	Greater than 25 percent of each habitat type in Sonoma County	None	C	=
8.4.5. Will the pipeline component cause permanent loss of sensitive native terrestrial plant communities?	Greater than 0 acres	None	C	=
8.4.6. Will the pipeline component substantially block or disrupt major terrestrial wildlife migration or travel corridors?	Greater than 0 corridors	None	C	=
8.4.7. Will the pipeline component result in ecological risk to terrestrial plant and wildlife populations (i.e., acute or chronic toxicity and bioaccumulation)?	Ecological Quotient (EQ) greater than 10	None	O&M	=

Source: Harland Bartholomew & Associates, Inc., 1996

Notes: 1. Type of Impact:
- C Construction
- O&M Operation and Maintenance

2. Level of Significance:
- ❍ Less than significant impact; no mitigation proposed
- = No impact

Impact: **8.4.1- 3, 6 - 7. Will the pipeline component impact terrestrial wildlife or plant species, wildlife habitats, or plant communities based on evaluation criteria 1, 2, 3, 6, 7?**

Analysis: *No Impact; All Alternatives.*

This analysis addresses potential impacts associated with all pipelines, except those that occur within agricultural irrigation areas, and the geysers steamfield area. Impacts to most sensitive resources will be avoided through implementation of Measure 2.2.5. adopted as part of the Project. Measure 2.2.5 provides programs to avoid environmentally sensitive areas along pipelines and establishes procedures for avoidance of construction impacts to special-status terrestrial wildlife and plant species. Preconstruction surveys will be conducted for sensitive biological resources prior to final Project design. Project siting and design will reflect avoidance of identified resources with an associated exclusionary buffer.

Habitat assessments were conducted within the proposed pipeline corridors to determine the feasibility of avoiding sensitive biological resources. Special-status plant and wildlife species were observed during these assessments. Two Rincon manzanita shrubs (California Native Plant Society List 1B) one population of serpentine bird's beak (California Native Plant Society List 4) and one population of Mt. St. Helena morning glory (California Native Plant Society List 4) were found along a pipeline segment associated with Alternative 4. Hayfield tarplant (California Native Plant Society List 3) was observed along a pipeline segment associated with Alternative 3. All of these resources will be avoided through pipeline realignment. Maps which show special-status species occurrences along pipeline routes can be found in *Biological Resources Technical Memorandum*, *Volume 4* (Harland Bartholomew & Associates, Inc. 1996c-g). Results of these assessments, intensive literature review, and coordination with the U.S. Fish and Wildlife Service and State Department of Fish and Game indicate that after implementation of Measure 2.2.5, pipelines:

- will not be constructed on occupied habitat of endangered, threatened or rare terrestrial wildlife or plant species (criterion #1);
- will not be constructed on occupied habitat of state proposed or listed terrestrial wildlife or plant species, or California Native Plant Society List 1B, 2, 3, or 4 terrestrial plant species (criterion #2);
- will not impact nesting raptors (criterion #3);

- will not block major terrestrial wildlife migration or travel corridors (criterion #7); and
- will not create a potential ecological risk to terrestrial organisms (criterion #8).

Alternatives 1 and 5B do not have a pipeline component.

Mitigation: No mitigation is needed.

Impact: 8.4.4. Will the pipeline component cause a permanent loss of sensitive terrestrial wildlife habitat?

Analysis: *No Impact; All Alternatives.*

Sensitive wildlife habitats are defined as habitats that provide high suitability for foraging and breeding for state species of special concern and California fully protected species, and important resting, foraging, and breeding habitat for migratory songbirds and other wildlife. Sensitive wildlife habitats that were identified within the pipeline corridors include coastal oak woodland, montane hardwood, and valley foothill riparian (Table 4.8-9).

Table 4.8-9

Sensitive Wildlife Habitats in Pipeline Corridors to Be Avoided (acres)

Alternative	Coastal Oak Woodland	Montane Hardwood	Valley Foothill Riparian
Tolay Extended	1.72	0.34	5.16
Adobe Road/Lakeville	1.72	0.34	5.16
Tolay Confined	1.72	0.34	5.18
Sears Point/Lakeville	1.72	0.34	5.19
Two Rock	1.72	0.34	8.08
Bloomfield	1.72	0.34	8.12
Carroll Road	1.72	0.34	8.08
Valley Ford	1.72	0.34	8.08
Huntley	1.72	0.34	8.08
Geysers Recharge	0.00	0.00	0.93
Russian River Discharge	1.38	6.50	1.62

Source: Harland Bartholomew & Associates, Inc. 1996

All of these habitats are also considered sensitive plant communities except annual grassland and will be avoided through implementation of Measure 2.2.5, Avoid Sensitive Biological Resources, adopted as part of the Project.

Within the 30-foot construction zone associated with the pipeline construction, it is estimated that no more than 100 acres of annual grassland will be temporarily lost due to pipeline construction of any alternative. This is much less than the point of significance (i.e., 25 percent loss of each habitat type in Sonoma and Marin counties). In addition, Measure 2.2.8, adopted as part of the Project, will result in the revegetation of pipeline construction scars with native grasses resulting in no permanent loss of annual grassland. Therefore this is a less than significant impact.

Alternatives 1 and 5B do not have a pipeline component.

Mitigation: No mitigation is needed.

Impact: 8.4.5. Will the pipeline component cause a permanent loss of sensitive native terrestrial plant communities?

Analysis: *No Impact; All Alternatives.*

Results of surveys within the pipeline corridors indicate that many of the pipeline locations support sensitive plant communities (see Table 4.8-10). The point location of these communities is in *Biological Resources Technical Memorandum, Volume 4E* (Harland Bartholomew & Associates, Inc. 1996g). All of these habitats will be avoided through Measure 2.2.5. Avoid Sensitive Biological Resources, adopted as part of the Project.

Alternatives 1 and 5B do not have a pipeline component.

Mitigation: No mitigation is needed.

Table 4.8-10

Sensitive Plant Communities in Pipeline Corridors to Be Avoided (acres)

Alternative	Mixed Riparian	Willow Riparian	Oak Woodland	Oak-Bay-Madrone Woodland
Tolay Extended	4.82	0.35	1.72	0.34
Adobe Road/Lakeville	4.82	0.35	1.72	0.34
Tolay Confined	4.82	0.38	1.72	0.34
Sears Point/Lakeville	4.82	0.39	1.72	0.34
Two Rock	4.46	3.67	1.72	0.34
Bloomfield	4.46	3.72	1.72	0.34
Carroll Road	4.46	3.67	1.72	0.34
Valley Ford	4.46	3.67	1.72	0.34
Huntley	4.46	3.67	1.72	0.34
Geysers Recharge	0.45	0.50	0.00	0.00
Russian River Discharge	1.45	1.21	1.38	6.54

Source: Harland Bartholomew & Associates, Inc. 1996

Storage Reservoir Component

Table 4.8-11

Terrestrial Biological Resources Impacts by Component - Storage Reservoirs

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
8.5.1. Will the storage reservoir component cause loss of individuals or occupied habitat of endangered, threatened, or rare terrestrial wildlife or plant species?	a. Greater than 0 individuals b. Greater than 0 acres	None	C, P	=

Table 4.8-11

Terrestrial Biological Resources Impacts by Component - Storage Reservoirs

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
8.5.2. Will the storage reservoir component cause loss of individuals of CNPS List 2, 3, or 4 terrestrial plant species?	Greater than 15 % of known occurrences in populations in Sonoma and Marin counties			
• Two Rock		10%	P	○
• Huntley		5%	P	○
• All other reservoirs		None	P	═
8.5.3. Will the storage reservoir component cause loss of active raptor nest sites?	Greater than 0 acres of suitable nesting habitat[3]	Greater than 0 acres	C, P	⊙
8.5.4. Will the storage reservoir component cause permanent loss of sensitive terrestrial wildlife habitat?	Greater than 25% of each habitat type in Marin and Sonoma counties[3]			
• Tolay Extended		3%	P	○
• Adobe Road		15%	P	○
• Tolay Confined		3%	P	○
• Lakeville Hillside		3%	P	○
• Sears Point		14%	P	○
• Two Rock		4%	P	○
• Bloomfield		2%	P	○
• Carroll Road		4%	P	○
• Valley Ford		4%	P	○
• Huntley		2%	P	○
8.5.5. Will the storage reservoir component cause permanent loss of sensitive native terrestrial plant communities?	Greater than 0 acres[4]			
• Tolay Extended		32	P	⊙
• Adobe Road		77	P	⊙
• Tolay Confined		32	P	⊙

Table 4.8-11

Terrestrial Biological Resources Impacts by Component - Storage Reservoirs

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
• Lakeville Hillside		12	P	⊙
• Sears Point		60	P	⊙
• Two Rock		75	P	⊙
• Bloomfield		11	P	⊙
• Carroll Road		18	P	⊙
• Valley Ford		10	P	⊙
• Huntley		7	P	⊙
8.5.6. Will the storage reservoir component substantially block or disrupt major terrestrial wildlife migration or travel corridors?	Greater than 0 corridors	None	C, P	=
8.5.7. Will the storage reservoir component result in ecological risk to terrestrial plant and wildlife populations (i.e., acute or chronic toxicity and bioaccumulation)?	Ecological Quotient (EQ) greater than 10	EQ less than 2.28	O&M	○

Source: Harland Bartholomew & Associates, Inc., 1996

Notes:
1. Type of Impact:
   - C — Construction
   - O&M — Operation and Maintenance
   - P — Permanent
   - -- — Not Applicable
2. Level of Significance:
   - ⊙ Significant impact before mitigation; less than significant impact after mitigation
   - ○ Less than significant impact; no mitigation proposed
   - = No impact
3. The most adverse impact on a population is represented here. See discussion of impact for percent affected per species.
4. The total impact of all sensitive plant communities is represented here. See discussion of impact for acreage affected per species.

Impact: **8.5.1. Will the storage reservoir component cause loss of individuals or occupied habitat of endangered, threatened, or rare terrestrial wildlife or plant species?**

Analysis: *No Impact; All Alternatives.*

Results of intensive special-status terrestrial wildlife and plant surveys indicate that none of the storage reservoir sites currently support endangered threatened, or rare terrestrial wildlife or plant species (See Aquatic Biological Resources section for discussion of amphibians). The proposed storage reservoirs and associated facilities (including dams,

access roads, pump stations, electrical distribution lines and diversion channels) will not result in the loss of individuals or populations or occupied habitat of the designated species. In addition, results of intensive literature review and coordination with the U.S. Fish and Wildlife Service indicate that habitats within the construction zone boundary of storage reservoir sites have not been designated as critical habitat for any federally-proposed or listed species by the U.S. Fish and Wildlife Service.

Alternatives 1, 4, and 5 do not have a storage reservoir component.

Mitigation: No mitigation is needed.

Impact: 8.5.2. Will the storage reservoir component cause a loss of populations of CNPS Lists 2, 3, or 4 terrestrial plant species?

Analysis: *Less than Significant; Alternatives 3A and 3E.*

Construction of the Huntley storage reservoir component will result in the loss of two populations of hayfield tarplant (Table 4.8-12). One of the populations is found near the center of the reservoir site and another population exists near the freshwater pond on the southeastern boundary of the site. These occurrences are presented on maps in *Biological Resources Technical Memorandum, Volume 4C* (Harland Bartholomew & Associates, Inc. 1996e). These populations consist of scattered individual plants occupying an area of less than 10,000 square feet, in an area that has been exposed to moderate to heavy grazing. Review of the records of the U.C. Berkeley Herbarium determined that twenty populations or occurrences of hayfield tarplant have been identified in Sonoma and Marin counties (eight in Marin County and ten in Sonoma County). An additional 15 populations were identified during surveys undertaken in support of this document (five in Marin County and 12 in Sonoma County). Therefore, there is a total of 37 known and historical records of hayfield tarplant in Sonoma and Marin counties. The two populations identified within the construction boundary zone on the Huntley storage reservoir site represent approximately five percent of the known populations of this species.

A loss of 15 percent or less of the known and historic records of hayfield tarplant in the region of the Project will not cause a substantial range contraction, result in the hayfield tarplant becoming threatened with extinction, or substantially diminish the habitat of hayfield tarplant (see CEQA Section 15065).

Construction of the Two Rock storage reservoir component will result in the loss of one population of bristly linanthus (Table 4.8-12). The location of this occurrence is presented on Map C-1 in *Biological Resources Technical Memorandum, Volume 4C* (Harland Bartholomew &

Associates, Inc. 1996e). Review of the records of the U.C. Berkeley Herbarium determined that nine populations or occurrences of bristly linanthus have been identified in Sonoma and Marin counties. One population was identified during surveys undertaken in support of this document. Therefore, there is a total of ten known and historical records of hayfield tarplant in Sonoma and Marin counties. The population at the Two Rock reservoir site represents approximately ten percent of the known populations of this species. A loss of 15 percent or less of the known and historic records of bristly linanthus in the region of the Project will not cause a substantial range contraction, and will not result in the bristly linanthus becoming threatened with extinction, or substantially diminish the habitat of bristly linanthus (see CEQA Section 15065).

Table 4.8-12

CNPS List 2, 3, or 4 Plants Impacted by Storage Reservoirs

Plant Species	Number of Populations	Percent of known populations
Bristly linanthus		
Two Rock	1	10%
All other reservoir sites	0	0%
Hayfield Tarplant		
Huntley	2	5%
All other reservoir sites	0	0%

Source: Harland Bartholomew & Associates, Inc. 1996

No Impact; Alternatives 2, 3B, 3C, and 3D.

Results of special-status plant surveys within the construction zone boundaries of the storage reservoir sites indicate that none of these sites currently support populations of CNPS List 2, 3, or 4 plant species. None of the storage reservoir components will therefore impact these species.

Alternatives 1, 4, and 5 do not have a storage reservoir component.

Mitigation: No mitigation is proposed.

Impact: **8.5.3. Will the storage reservoir component cause loss of active raptor nest sites?**

Analysis: *Significant; Alternatives 2 and 3.*

Focused surveys for raptor nest sites (i.e., hawks and owls) were not conducted on the storage reservoir sites, however, suitable nesting habitat was identified on all reservoir sites. Noise and visual disturbance associated with construction activities occurring during the nesting season may disrupt nesting raptors leading to nest abandonment and nest failure. Construction activities will destroy active nest sites. Grading and inundation of the reservoir sites during the nesting season will flood nest sites or disrupt nesting behaviors leading to nest failure.

No Impact; Alternatives 1, 4, and 5.

These alternatives do not have a storage reservoir component.

Mitigation: *Alternatives 2 and 3.*

2.4.5. Active Raptor Nest Location and Monitoring Program

Alternatives 1, 4, and 5. No mitigation is needed.

After Mitigation: *Less than Significant; Alternatives 2 and 3.*

Potential active raptor nest sites within 0.25 miles of the construction zone will be identified during preconstruction surveys. Construction activities within 0.25 miles of active raptor nests and initial inundation of reservoir sites will be scheduled to occur outside of the nesting season (April-July). Therefore impacts to nesting raptors will be avoided.

Impact: **8.5.4. Will the storage reservoir component cause permanent loss of sensitive terrestrial wildlife habitat?**

Analysis: *Less than Significant; Alternatives 2 and 3.*

The storage reservoir component will result in the loss of annual grassland, coastal scrub, coastal oak woodland, montane hardwood, and valley foothill riparian wildlife habitats (Table 4.8-13) (the habitat types are classified according to the Wildlife Habitat Relationship system, see Table 4.8-14). Maps A-1 through A-7 of *Biological Resources, Volume 4A* illustrate the wildlife habitats mapped for each reservoir site (Harland Bartholomew & Associates, Inc. 1996g). These are valuable wildlife habitats, providing cover, breeding, and foraging habitat for a variety of wildlife species, including state species of special concern and California fully protected species.

Valley foothill riparian habitat is especially important for resting, foraging, and nesting neotropical migrant songbirds (birds that breed in North America and migrate to Mexico, Central and South America to spend the winter) Table 4.8-14 provides a list of potential sensitive species found in these habitats and those observed during field surveys for this Project.

This impact is determined by comparison of mapped habitat on each storage reservoir site with the total mapped habitat for Sonoma and Marin Counties per California Department of Forestry's California Vegetation map (CalVeg) or total mapped habitat within the reservoir and agricultural irrigation areas. See *Biological Resources, Volume 1* for more information on California vegetation mapping (Harland Bartholomew & Associates, Inc. 1996a). For each habitat type the impacted acreage in each reservoir site is less than the point of significance, 25% of the Marin and Sonoma acreage. In fact, the total of all habitat types affected on each reservoir is also less than 25% of the Marin/Sonoma acreage. Therefore, impacts on terrestrial wildlife habitats are less than significant at all reservoir sites.

Coastal oak woodland, montane hardwood, and valley foothill riparian are valuable not just as wildlife habitat as evaluated under this criterion, but also as sensitive plant communities under criterion 5. Under criterion 5, impacts to these habitats will be mitigated through measure 2.3.11, Sensitive Resource Conservation Program.

Alternatives 1, 4, and 5 do not have a storage reservoir component.

Mitigation: No mitigation is proposed.

Table 4.8-13

Sensitive Wildlife Habitat Impacted by Storage Reservoirs

Community	Acres	Percent of habitat type in Sonoma & Marin Counties (%)
Annual Grassland		
Tolay Extended	413	3
Adobe Road	271	2
Tolay Confined	343	2
Lakeville Hillside	178	1
Sears Point	397	2
Two Rock	264	2
Bloomfield	320	2

Table 4.8-13

Sensitive Wildlife Habitat Impacted by Storage Reservoirs

Community	Acres	Percent of habitat type in Sonoma & Marin Counties (%)
Carroll Road	276	2
Valley Ford	362	2
Huntley	283	2
Coastal Scrub		
Bloomfield	5	< 1
Carroll Road	3	< 1
Other reservoirs	0	0
Coastal Oak Woodland		
Adobe Road	15.2	< 1
Sears Point	5	< 1
Other Reservoirs	0	0
Montane Hardwood		
Two Rock	58	< 1
Bloomfield	1	< 1
Valley Ford	1	< 1
Other reservoirs	0	0
Valley Foothill Riparian		
Tolay Extended	8	3
Adobe Road	61	15
Tolay Confined	8	3
Lakeville Hillside	11	3
Sears Point	59	14
Two Rock	16	4
Bloomfield	10	2
Carroll Road	18	4
Valley Ford	9	2
Huntley	5	1

Source: Harland Bartholomew & Associates, Inc. 1996

Percentages of impacted habitat were calculated based on the following data:
Annual Grassland - (16,844 acres) acreage mapped by Harland Bartholomew & Associates
Coastal Scrub - (73,361 acres) acreage from Cal Veg data
Coastal Oak Woodland - (28,356 acres) acreage from Cal Veg data
Montane Hardwood - (20,367 acres) acreage from Cal Veg data
Valley Foothill Riparian - (407 acres) acreage mapped by Harland Bartholomew & Associates, Inc. (because riparian habitat is not mapped in Cal Veg, this number represents a minimum acreage of this habitat type)

Table 4.8-14

Special-Status Wildlife Species Associated with Wildlife Habitat Relationship System Habitat Types (High Suitability Only)

Wildlife Species	Observed During Surveys	Annual Grassland	Coastal Scrub	Coastal Oak Woodland	Montane Hardwood	Valley Foothill Riparian
Pallid bat[1]	No	F		F		
Ringtail[1]	No					F, R
White-tailed kite[2]	Yes	F		R		R
Northern harrier[1]	Yes	F, R				
Ferruginous hawk[1]	No	F				
Golden eagle[1]	Yes	F		R	R	
Prairie falcon[1]	Yes	F				
Long-billed curlew[1]	No	F				
Tricolored blackbird[1]	Yes	F				
Sharp-shinned hawk[1]	Yes		F	F	F, R	F
Cooper's hawk[1]	Yes		F	F, R	F, R	F, R
Merlin[1]	Yes					F
Burrowing owl[1]	Yes	F, R				
Yellow warbler[1]	No			F		F, R
Yellow-breasted chat[1]	No			F		F

Source: Harland Bartholomew & Associates, 1996

Notes:
F = high suitability for foraging
R = high suitability for reproduction
1 Species of special concern, California Department of Fish and Game
2 Fully protected,

Impact: **8.5.5. Will the storage reservoir component cause the permanent loss of sensitive native terrestrial plant communities?**

Analysis: *Significant; Alternatives 2 and 3.*

Storage reservoirs and associated facilities will result in the loss of oak woodland at Adobe Road, Sears Point, Two Rock, Bloomfield, Valley Ford; riparian woodland at all reservoir sites; and native grassland at Tolay Extended, Tolay Confined, Lakeville Hillside, Two Rock, Carroll Road, Huntley (see Table 4.8-15).

Each of the plant communities discussed above has undergone tremendous reduction in distribution and acreage over the past 100 years and is considered sensitive by the California Department of Fish and Game. Any loss of these communities is a significant impact.

Table 4.8-15

Sensitive Native Plant Communities at Reservoir Sites (acres)

Reservoir	Oak Woodland	Riparian Woodland	Native Grassland
Tolay Extended	0	7	25
Adobe Road	17	60	0
Tolay Confined	0	7	24
Lakeville Hillside	0	11	0.6
Sears Point	6.2	59	0
Two Rock	58	16	1
Bloomfield	0.6	10	0
Carroll Road	0	17	1
Valley Ford	1	9	0
Huntley	0	5	2

Source: Harland Bartholomew & Associates, Inc., 1996

No Impact; Alternatives 1, 4, and 5.

These alternatives do not have a storage reservoir component.

Mitigation: *Alternatives 2 and 3.*

2.3.11. Sensitive Resource Conservation Program

Alternatives 1, 4 and 5. No mitigation is needed.

After Mitigation: *Less than Significant; Alternatives 2 and 3.*

Loss of sensitive native plant communities will be compensated through creation of new habitats, or restoration and preservation of existing habitat. Monitoring will ensure no net loss of habitat acreage or function.

Impact: 8.5.6. Will the storage reservoir component substantially block or disrupt major terrestrial wildlife migration or travel corridors?

Analysis: *No Impact; All Alternatives.*

Results of literature reviews and discussions with California Department of Fish and Game (Fred Bottie, Biologist, California Department of Fish and Game Region 3, Yountville, personal communication, September 1995) indicate that no major terrestrial wildlife migration or travel corridors are located within the construction zone boundary of any storage reservoir site. Construction of the storage reservoirs and associated facilities will not block or disrupt major terrestrial wildlife migration or travel corridors.

Alternatives 1, 4, and 5 do not have a storage reservoir component.

Mitigation: No mitigation is needed.

Impact: 8.5.7. Will the storage reservoir component result in ecological risk to terrestrial plant and wildlife populations (i.e., acute or chronic toxicity and bioaccumulation)?

Analysis: *Less than Significant; Alternatives 2 and 3.*

Based on the ecological risk assessment, no significant risk was identified for direct exposure of terrestrial organisms to organic chemicals and metals found at detectable levels in the reclaimed water or in the sediment. All ecological quotient (EQ) values for sediment or reclaimed water were below the significance threshold of 10. The risk to vegetation from the sediment, has an EQ less than 2.28, and so the impacts are considered to be less than significant. The EQ values for bioaccumulation of metals in the diet, as measured by food ingestion in the mallard, were well below significance levels, EQ less than 0.01, and therefore the impact of bioaccumulation is also less than significant.

No Impact; Alternatives 1, 4, and 5.

These alternatives do not have a reservoir component.

Mitigation: No mitigation is proposed.

Pump Station Component

This analysis addresses potential impacts associated with all pump stations, except those which occur within storage reservoir construction zones. The storage reservoir pump station impacts are addressed in the storage reservoir impact analysis, because they are within the construction zone for the reservoirs.

Table 4.8-16

Terrestrial Biological Resources Impacts by Component - Pump Stations

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
8.6.1. Will the pump station component cause loss of individuals or occupied habitat of endangered, threatened, or rare, terrestrial wildlife or plant species?	Greater than 0 individuals and Greater than 0 acres	None	P	═
8.6.2. Will the pump station component cause loss of individuals of CNPS List 2, 3, or 4 terrestrial plant species?	Greater than 15% of known occurrences or populations in Sonoma County	None	P	═
8.6.3. Will the pump station component cause loss of active raptor nest sites?	Greater than 0 active nest sites	None	P	═
8.6.4. Will the pump station component cause permanent loss of sensitive terrestrial wildlife habitat?	Greater than 25% of each habitat type in Sonoma County	Less than 1%	C	O
8.6.5. Will the pump station component cause permanent loss of sensitive native terrestrial plant communities?	Greater than 0 acres	None	P	═
8.6.6. Will the pump station component substantially block or disrupt major terrestrial wildlife migration or travel corridors?	Greater than 0 corridors	None	P	═
8.6.7. Will the pump station component result in ecological risk to terrestrial plant and wildlife populations (i.e., acute or chronic toxicity and bioaccumulation)?	EQ Greater than 10	None	P	═

Source: Harland Bartholomew & Associates, Inc., 1996

Notes: 1. Type of Impact:
P Permanent
C Construction

2. Level of Significance codes:
═ No impact
O Less than significant impact; no mitigation proposed

Impact: **8.6.1-3, 6-7. Will the pump station component impact terrestrial wildlife or plant species based on evaluation criteria 1, 2, 3, 6, and 7?**

Analysis: *No Impact; All Alternatives.*

Measure 2.2.5, Avoid Sensitive Biological Resources, adopted as part of the Project, provides measures to avoid environmentally sensitive areas near pump stations and electrical systems and establishes procedures for avoidance of construction impacts to wildlife or plant species and occupied habitats. Preconstruction surveys will be conducted for sensitive biological resources prior to final Project design. Project siting and design will reflect avoidance of identified resources with an associated exclusionary buffer. Construction within a 0.25 mile buffer of raptor nests will be timed to occur prior to or after the nesting season.

Results of habitat assessments, literature review, and coordination with the U.S. Fish and Wildlife Service and the state Department of Fish and Game indicate that after implementation of Measure 2.2.5., the pump station component:

- Will not be constructed on occupied habitat for endangered, threatened, or rare, proposed, or federal candidate terrestrial wildlife or plant species (criterion #1);
- Will not be constructed in habitat that supports CNPS List 2, 3, or, 4 terrestrial plant species (criterion #2);
- Will not impact nesting raptors (criterion #3);
- Will not block major terrestrial wildlife migration or travel corridors (criterion #7); and
- Will not create a potential ecological risk to terrestrial organisms (criterion #8).

Alternatives 1, 4 and 5 do not have a storage reservoir component.

Mitigation: No additional mitigation is needed.

Impact: **8.6.4. Will the pump station component cause permanent loss of sensitive terrestrial wildlife habitat?**

Analysis: *Less than Significant; Alternatives 2, 3, and 4.*

Results of the habitat assessments indicate that there are sensitive wildlife habitats present (i.e. coastal oak woodland, valley foothill riparian habitat, and annual grassland) within the current pump station construction zones. With the exception of annual grassland and coastal scrub habitat, all other

sensitive wildlife habitat identified are also considered sensitive plant communities. With implementation of Measure 2.2.5, adopted as part of the Project, all sensitive plant communities will be avoided in the construction of pump stations.

Surveys indicate that there will be less than nine acres of annual grassland habitat impacted by any alternative. Of that, no greater than one acre will be lost permanently. The remaining acreage will be temporarily impacted through construction activities. The construction scars will be restored to their original form through implementation of Measure 2.2.8 Revegetate Temporarily Disturbed Sites, adopted as part of the Project. The total permanent loss of annual grassland is much less than the point of significance threshold of 25% of any habitat type in Sonoma and Marin counties and this impact is less than significant.

No Impact; Alternatives 1 and 5.

These alternatives do not have a pump station component.

Mitigation: No additional mitigation is proposed.

Impact: **8.6.5. Will the pump station component cause permanent loss of sensitive native terrestrial plant communities?**

Analysis: *No Impact; All Alternatives.*

Habitat assessments were conducted to identify sensitive vegetative communities potentially affected by the proposed pump station locations. Two proposed pump stations (G3 and G4), are located in the vicinity of well-developed stands of oak-bay-madrone woodland. Each of these pump stations will have an approximate construction zone boundary of one acre, resulting in the combined loss of at least two acres of oak-bay-madrone woodland.

Measure 2.2.5, adopted as part of the Project, provides measures to avoid sensitive plant communities near pump stations and electrical systems and establishes procedures for avoidance of construction impacts to wildlife or plant species and occupied habitats. Project siting and design will reflect avoidance of identified resources with an associated exclusionary buffer.

Because exclusionary buffers for sensitive biological resources will be incorporated into the final Project design there will be no impacts to sensitive native terrestrial plant communities.

Alternatives 1 and 5 do not have a pump station component.

Mitigation: No additional mitigation is needed.

Agricultural Irrigation Component

Table 4.8-17

Terrestrial Biological Resources Impacts by Component - Agricultural Irrigation

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
8.7.1. Will the agricultural irrigation component cause loss of individuals or occupied habitat of endangered, threatened, or rare terrestrial wildlife or plant species?	a. Greater than 0 individuals b. Greater than 0 acres	None Temporary impacts due to accidental ponding or runoff only	C, P O&M	= O
8.7.2. Will the agricultural irrigation component cause loss of individuals of CNPS List 2, 3, or 4 terrestrial plant species?	Greater than 15% of known occurrences or populations in Sonoma and Marin counties	None Temporary impacts due to accidental ponding or runoff only.	C, P O&M	= O
8.7.3. Will the agricultural irrigation component cause loss of active raptor nest sites?	Greater than 0 active nest sites	None	C, P, O&M	=
8.7.4. Will the agricultural irrigation component cause permanent loss of sensitive terrestrial wildlife habitat?	Greater than 25% of each habitat type in Sonoma and Marin counties	19% to 22% loss	C, P, O&M	O
8.7.5. Will the agricultural irrigation component cause permanent loss of sensitive native terrestrial plant communities?	Greater than 0 acres	None Temporary impacts due to accidental ponding or runoff only	C, P, O&M	= O
8.7.6. Will the agricultural irrigation component substantially block or disrupt major terrestrial wildlife migration or travel corridors?	Greater than 0 corridors	None	C, P	=

Table 4.8-17

Terrestrial Biological Resources Impacts by Component - Agricultural Irrigation

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
8.7.7. Will the agricultural irrigation component result in ecological risk to terrestrial plant and wildlife populations (i.e., acute or chronic toxicity and bioaccumulation)?	EQ Greater than 10	EQ between 0.00 and 0.01	O&M, O&M-CP	O

Source: Harland Bartholomew & Associates, Inc., 1996

Notes: 1. Type of Impact:
O&M Operation and Maintenance
O&M-CP Contingency Plan
P Permanent

2. Level of Significance codes:
O Less than significant impact; no mitigation proposed
= No impact

Impact: **8.7.1. and 8.7.2 Will the agricultural irrigation component cause loss of individuals or occupied habitat of endangered, threatened, or rare terrestrial wildlife or plant species; loss of individuals of CNPS List 1B, 2, 3, or 4 terrestrial plant species?**

Analysis: ***Construction, Permanent***

No Impact; All Alternatives.

Results of habitat assessments for special-status plant and wildlife species within proposed agricultural irrigation areas indicate that all of the agricultural areas currently support habitat for these species see *Biological Resources Technical Memorandum Volumes 1, 2, and 4D* for detailed methodology and survey results with maps (Harland Bartholomew & Associates, Inc. 1996a, b, f). In addition, over the life of the Project, there is an opportunity for future protection of species that do not currently have special-status, but do occupy these lands. Therefore, there is potential for special-status species to occur on agricultural sites when they receive irrigation waters. Measures adopted as part of the Project will ensure that all impacts to special-status species are avoided.

Measure 2.2.2 and Measure 2.2.5 will result in avoidance of impacts to these resources. In Measure 2.2.2, the City will compile a resource map for every irrigation parcel immediately prior to irrigation design and layout. Irrigation design (Measure 2.2.5) will reflect exclusionary buffers for both irrigation application and pipeline construction. Exclusionary buffers will be established around any identified sensitive plant species

habitat, the riparian corridor of all linear waterways, and occupied burrows or nest sites of sensitive ground-dwelling wildlife species. Thus, agricultural irrigation will not result in the loss of individuals, populations or occupied habitat, and therefore there is no impact.

Alternatives 1, 4, and 5 do not have an agricultural irrigation component.

Operation and Maintenance

Less than Significant; Alternative 2 and 3.

Irrigation runoff and ponding may occur due to faulty operation or pipeline leakage. Measures adopted as part of the Project (Measure 2.2.1) are designed to avoid runoff and ponding. Measure 2.2.2 (Irrigation Site Resource Maps) and Measure 2.2.5 (Avoid Sensitive Biological Resources) are also designed to avoid the potential effects of runoff and ponding by providing for identification and buffering of special-status terrestrial plant and wildlife species and occupied habitats. Therefore, any potential impacts to the designated species and occupied habitats will be less than significant.

Winter irrigation will occur in areas previously evaluated for normal summer irrigation. Results of habitat assessments for sensitive plant communities and wildlife habitats within agricultural irrigation areas indicate that some of the agricultural irrigation areas contain sensitive plant communities and habitats that support sensitive wildlife (see Agricultural Irrigation Impact Analysis). However, Measure 2.2.2, Irrigation Site Resource Maps, ensures that the results of previous biological surveys are verified and that additional special-status species surveys will be conducted on those parcels that were not previously surveyed.

No Impact; Alternatives 1, 4, and 5.

These alternatives do not have an agricultural irrigation component.

Mitigation: No additional mitigation is proposed.

Impact: 8.7.3. Will the agricultural irrigation component cause loss of active raptor nest sites?

Analysis: *No Impact; All Alternatives.*

Raptor nesting behavior and nesting success could be affected by the physical, noise and visual disturbances associated with the construction of pipelines, cultivation practices and the aerial application of irrigation water. Active raptor nest sites may be present on all irrigation sites but all impacts will be avoided through the implementation of measures adopted as part of the Project.

In Measure 2.2.2, the City will compile a resource map for every irrigation parcel immediately prior to irrigation design and layout. Irrigation design (Measure 2.2.5) will reflect exclusionary buffers for both irrigation application, new cultivation, and pipeline construction for active raptor nests.

Irrigation runoff and ponding may occur due to faulty operation or pipeline leakage. However, due to the low volumes of water involved, the transitory nature of potential effects, and the implementation Measure 2.2.1- Irrigation Conservation and Management Programs, Measure 2.2.2 - Irrigation Site Resource Maps, and Measure 2.2.5 - Avoid Sensitive Biological Resources including active raptor nest sites potential impacts to raptor nest sites will be avoided. Therefore, there will be no impact.

Alternatives 1, 4, and 5 do not have an agricultural irrigation component.

Mitigation: No additional mitigation is needed.

Impact: 8.7.4. Will the agricultural irrigation component cause permanent loss of sensitive terrestrial wildlife habitat?

Analysis: *Less than Significant; Alternatives 2 and 3.*

Assessments of sensitive wildlife habitat were conducted on each agricultural subcomponent. See discussion on pipeline impact 8.6.6 for definition of sensitive wildlife habitat. Results of the surveys are presented in Tables 4.8-18, 19, and 20.

Table 4.8-18

Sensitive Terrestrial Wildlife Habitats
South County Agricultural Irrigation (Alternative 2)
(acres)

Habitat	Adobe Road	East of Rohnert Park	Lakeville	North Petaluma Valley	Bay Flats	Total South County
Annual Grassland	1,162.	1,214	2,152	381	--	5,591
Coastal Oak Woodland	1	61	12	95	682	80
Valley Foothill Riparian	1	33	1	4	--	39
Montane Hardwood	--	43	--	--	--	43

Source: Harland Bartholomew & Associates, Inc., 1996

Notes:
Numbers under "Acres" heading indicate the total acreage mapped for that particular agricultural area.

Table 4.8-19

Sensitive Terrestrial Wildlife Habitats - Sebastopol Agricultural Irrigation (Alternative 2 and 3) (acres)

Habitat	Sebastopol (Acres)
Annual Grassland	371
Coastal Oak Woodland	35
Valley Foothill Riparian	92
Redwood	14
Montane Hardwood	11

Source: Harland Bartholomew & Associates, Inc., 1996

Notes:
Numbers under "Acres" heading indicate the total acreage mapped for that particular agricultural area.

Table 4.8-20

Sensitive Terrestrial Wildlife Habitats - West County Agricultural Irrigation (Alternative 3) (acres)

Habitat	Americano	Miscellaneous	Stemple	Total West County
Annual Grassland	3,203	220	4,392	7,815
Valley Foothill Riparian	9	2	13	24
Coastal Oak Woodland	--	<1	<1	<1
Montane Hardwood	--	--	8	8
Coastal Scrub	4	--	--	4

Source: Harland Bartholomew & Associates, Inc., 1996

Notes:
Numbers under "Acres" heading indicate the total acreage mapped for that particular agricultural area.

All of the habitats in Tables 4.8-18, 19, and 20 are protected under Measure 2.2.5, Avoid Sensitive Biological Resources adopted as part of the Project, as sensitive plant communities, with the exception of annual grasslands and coastal scrub. Thus valley foothill riparian, coastal oak

woodland, and montane hardwood communities will not be included in irrigation areas, but will be avoided. The potential conversion of annual grassland and coastal scrub to cropland will result in decreased value and capability of this habitat to support sensitive terrestrial wildlife species. The potential loss of coastal scrub represents less than 0.01% and is less than significant.

Because the exact boundaries of agricultural irrigation for Alternatives 2 and 3 have not been defined, potential annual grassland conversion to cropland has been estimated upon the following assumptions:

- Conversion to irrigated pasture or silage (forage) will not substantially diminish sensitive wildlife use;

- Predicted cropping patterns and acreage are based on the high technological cropping scenarios developed in Cropping Scenarios For the West County and South County Reclamation Alternatives (1996). High technological cropping scenarios result in the largest acreage of land conversions for this Project; and

- With the exception of Sebastopol (utilizing the most conservative approach) all agricultural production is assumed to occur on annual grasslands. It is assumed in this analysis, as it is for the cropping analysis, that Sebastopol irrigation will include 1,600 acres of existing orchards and vineyards.

The results of this analysis are presented in Table 4.8-21. For all alternatives the maximum loss of annual grassland is less than the 25% point of significance Therefore this impact is less than significant.

Table 4.8-21

Maximum Predicted Acreage of Annual Grassland Converted to Other Agricultural Uses

Alternative	Maximum Annual Grassland Available for Conversion (Acres)	Maximum Irrigable Acreage Required for Alternatives 2 and 3 (Acres)	Predicted Conversion to Irrigated Pasture (Acres)	Predicted Conversion to Forage, Hay Silage (Acres)	Existing Cropland Assumed Irrigated within Scenario (Acres)	Predicted Conversion of Annual Grassland to Cultivated Crops (Acres)	Percentage of Annual Grassland Converted to Cultivated Crops
West County	7,815	6,800	1,000	2,300		3,500	21%
West County with Sebastopol	8,186	6,800	750	1,300	1,600	3,150	19%
South County	5,591	4,200	300	800		3,100	18%
South County with Sebastopol	5,960	5,100	200	400	1,600	2,900	17%

Source: Harland Bartholomew & Associates, Inc., 1996

Percentages of habitat impacted were calculated based on the following data:
Annual Grassland - (16,884 acres) acreage mapped in Sonoma and Marin Counties during this study by Harland Bartholomew & Associates, Inc

Irrigation runoff and ponding may occur due to faulty operation or pipeline leakage. However, due to the low volumes of water involved, the transitory nature of potential effects, and the small acreages of sensitive wildlife habitat potentially affected by runoff or ponding, the 25 percent threshold for loss of sensitive wildlife habitat will not be exceeded. In addition, implementation of Measure 2.2.1 - Irrigation Conservation and Management Programs, Measure 2.2.2 - Irrigation Site Resource Maps, and Measure 2.2.5 - Avoid Sensitive Biological Resources will ensure that potential impacts will be minimized and there will be no permanent loss of sensitive terrestrial wildlife habitats. Therefore, this impact is considered less than significant.

No Impact; Alternatives 1, 4, and 5.

Theses alternatives do not have an agricultural irrigation component.

Mitigation: No additional mitigation is proposed.

Impact: **8.7.5. Will the agricultural irrigation component cause permanent loss of sensitive native terrestrial plant communities?**

Analysis: ***Construction; Permanent***

No Impact; All Alternatives.

Measures adopted by the City as part of the Project (Measure 2.2.2 and Measure 2.2.5) will compile a resource map for every potential irrigation parcel, ensure that biological surveys are verified; and protect sensitive areas within agricultural irrigation areas by establishing buffers for all sensitive biological resources located on all parcels brought into agricultural production with reclaimed water. Therefore, agricultural irrigation will not result in the permanent loss of any sensitive native terrestrial plant community.

The Adobe Road agricultural irrigation area contains mixed riparian woodland, coast live oak woodland, and willow-dominated riparian woodland. The bay flats agricultural irrigation area contains some small patches of native grassland. The East of Rohnert Park agricultural irrigation area contains coast live oak woodland, oak-bay-madrone woodland, mixed riparian woodland, willow-dominated riparian woodland, and native grassland. The Lakeville agricultural irrigation area contains oak woodland, mixed riparian woodland, willow-dominated riparian woodland, and native grassland. The North Petaluma Valley agricultural irrigation area contains coast live oak woodland and mixed riparian and willow-dominated riparian woodland. The Americano agricultural irrigation area contains native grassland, willow-dominated riparian woodland, and less than 0.5 acres of mixed riparian woodland. The Stemple agricultural irrigation area contains both mixed riparian

woodland and willow-dominated riparian woodland. The Miscellaneous agricultural irrigation area contains both mixed riparian woodland and willow-dominated woodland. The Sebastopol agricultural irrigation area contains coastal oak woodland, mixed riparian woodland (over 100 acres), and willow-dominated riparian woodland. See *Biological Resources Technical Memorandum, Volume 4D* for mapping results (Harland Bartholomew & Associates, Inc. 1996g)

All of these communities will be avoided through Measures 2.2.2 and 2.2.5, therefore there is no impact.

Alternatives 1, 4, and 5 do not have an agricultural irrigation component.

Operation and Maintenance

Less than Significant; Alternatives 2 and 3.

Irrigation runoff and ponding may occur due to faulty operation or pipeline leakage. Measure 2.2.1 is designed to avoid runoff and ponding. Measure 2.2.2 (Irrigation Site Resource Maps) and Measure 2.2.5 (Avoid Sensitive Biological Resources) are also designed to avoid the potential effects of runoff and ponding by providing for identification and buffering of sensitive biological resources, including sensitive native terrestrial plant communities. However, due to the low volumes of water involved, the transitory nature of potential effects, and the small acreages of sensitive native plant communities potentially affected by runoff or ponding, the impact will be considered less than significant.

No Impact; Alternatives 1, 4 and 5.

These alternatives do not have an agricultural irrigation component.

Mitigation: No additional mitigation is proposed.

Impact: 8.7.6. Will the agricultural irrigation component substantially block or disrupt major terrestrial wildlife migration or travel corridors?

Analysis: *No Impact; All Alternatives.*

Results of literature reviews and discussions with the California Department of Fish and Game (Fred Bottie, Biologist, Region 3, Yountville, personal communication, September 1995) indicate that no major terrestrial wildlife migration or travel corridors are located within the agricultural irrigation areas. Application of reclaimed water at the agricultural irrigation areas will not block or disrupt major terrestrial wildlife migration or travel corridors, therefore there is no impact.

Alternatives 1, 4, and 5 do not have an agricultural irrigation component.

Mitigation: No mitigation is needed.

Impact: **8.7.7. Will the agricultural irrigation component result in ecological risk to terrestrial plant and wildlife populations (i.e., acute or chronic toxicity and bioaccumulation)?**

Analysis: *Less than Significant; Alternatives 2 and 3.*

Ecological quotients (EQ) were calculated for the exposure of vegetation and soil organisms to undiluted effluent applied directly to agricultural fields. The EQ for risk to vegetation and soil organisms from exposure to soils irrigated with undiluted effluent range from 0.00 to 0.01. All EQ values are below the significance threshold of 10, and therefore the impact is less than significant. The same analysis applies to winter irrigation under the Contingency Plan.

No Impact; Alternatives 1, 4, and 5.

These alternatives do not have an agricultural irrigation plan.

Mitigation: No mitigation is proposed.

Geysers Steamfield Component

Table 4.8-22

Terrestrial Biological Resources Impacts by Component - Geysers Steamfield

Evaluation Criteria	Point of Significance	Impact	Type of Impact	Level of Significance
8.8.1. Will the geysers steamfield component cause loss of individuals or occupied habitat of endangered, threatened, or rare, terrestrial wildlife or plant species?	a. Greater than 0 individuals and b. Greater than 0 acres	None	P	==
8.8.2. Will the geysers steamfield component cause loss of individuals of CNPS List 2, 3, or 4 terrestrial plant species?	Greater than 15 percent of known occurrences or populations in Sonoma and Marin counties	None	P	==
8.8.3. Will the geysers steamfield component cause loss of active raptor nest sites?	Greater than 0 active nest sites	None	P	==

Table 4.8-22

Terrestrial Biological Resources Impacts by Component - Geysers Steamfield

Evaluation Criteria	Point of Significance	Impact	Type of Impact	Level of Significance
8.8.4. Will the geysers steamfield component cause permanent loss of sensitive terrestrial wildlife habitat?	Greater than 25 percent of each habitat type in Sonoma and Marin counties	Less than 1%	P	O
8.8.5. Will the geysers steamfield component cause permanent loss of sensitive native terrestrial plant communities?	Greater than 0 acres	None	P	==
8.8.6. Will the geysers steamfield component substantially block or disrupt major terrestrial wildlife migration or travel corridors?	Greater than 0 corridors	None	P	==
8.8.7. Will the geysers steamfield component result in ecological risk to terrestrial plant and wildlife populations (i.e., acute or chronic toxicity and bioaccumulation)?	EQ Greater than 10	None	--	==

Source: Harland Bartholomew & Associates, Inc., 1996

Notes: 1. Type of Impact:
-- Not Applicable
P Permanent

2. Level of Significance:
O Less than significant impact; no mitigation proposed
= No impact

Impact: **8.8.1-3, 5, 6, and 7. Will the geysers steamfield component impact terrestrial wildlife or plant species based on evaluation criteria 1-3, 5, 6, and 7?**

Analysis: *No Impact; All Alternatives.*

Results of terrestrial habitat assessments, intensive literature review, and coordination with the U.S. Fish and Wildlife Service and the state Department of Fish and Game indicate that the geysers storage tank locations, pipelines, and access roads will be sited and constructed in areas which:

- do not support rare, threatened, or endangered terrestrial wildlife or plant species, or habitat therefore (criterion #1);

- do not support the California Native Plant Society List 2, 3, or, 4 terrestrial plant species (criterion #2);

- will not impact nesting raptors (or timing of the Project will not affect) nesting raptors (criterion #3);

- do not support sensitive plant communities (criterion #5);

- will not block major terrestrial wildlife migration or travel corridors (criterion #6); and

- will not create a potential ecological risk to terrestrial organisms via reclaimed water transfer by pipeline to the geysers steamfield area (criterion #8).

Measure 2.2.5, adopted as part of the Project, to avoid sensitive biological resources along pipelines, pump stations, and electrical systems and establishes procedures for avoidance of construction impacts to terrestrial wildlife or plant species and occupied habitats. Preconstruction surveys will be conducted for sensitive biological resources prior to final Project design. Project siting and design will reflect avoidance of identified resources with an associated exclusionary buffer. Active raptor nests will be avoided or the construction will occur outside the nesting season. Therefore, there is no impact.

Mitigation: No mitigation is needed.

Impact: **8.8.4. Will the geysers steamfield component cause permanent loss of sensitive terrestrial wildlife habitat?**

Analysis: *Less than Significant; Alternative 4.*

Re-sizing of the current injection well locations will not result in the loss of any sensitive terrestrial wildlife habitat. Construction of pipelines could result in the temporary loss of sensitive wildlife habitats. All sensitive wildlife habitats are also considered sensitive vegetation communities except mixed chaparral and annual grasslands. Measure 2.2.5 avoids environmentally sensitive vegetative communities along pipelines, pump stations, and electrical systems and establishes procedures for avoidance and minimization of construction impacts to special-status species and habitats. Preconstruction surveys will be conducted for sensitive biological resources prior to final Project design. Project siting and design will reflect avoidance of identified resources with an associated exclusionary buffer. In addition implementation of Measure 2.2.8 will result in the revegetation of pipeline construction scars with native grasses.

Pipelines will be constructed along existing roadways and pipeline alignments. New alignments will be above ground with minimal ground disturbance. Loss of annual grassland and mixed chaparral habitats will be less than one acre.

The designated construction zone for the storage tanks will be designed to allow a minimum 100-foot exclusionary buffer for all sensitive biological resources (including sensitive terrestrial wildlife habitat). Construction of the geysers storage tanks will result in the loss of annual grassland or mixed chaparral. The estimated total acreage of habitat that will be permanently or temporarily lost is less than one acre, based on the size of the storage tanks (each tank is 80 feet in diameter and both tanks combined will occupy an area of approximately 0.25 acres) and assuming a 100-foot construction buffer around these tanks.

Because exclusionary buffers for sensitive biological resources will be incorporated into the final Project design, the permanent loss of sensitive terrestrial wildlife habitats will be minimized. The percent loss of annual grassland and mixed chaparral terrestrial wildlife habitat is minimal (less than three acres) and is substantially less than a 25 percent loss of each habitat type. As a result, the impact will be less than significant.

No Impact; Alternatives 1, 2, 3, and 5.

These alternatives do not have a geysers steamfield component.

Mitigation: No mitigation is proposed.

Discharge Component

Table 4.8-23

Terrestrial Biological Resources Impacts by Component - Discharge

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
8.9.1. Will the discharge component cause loss of individuals or occupied habitat of endangered, threatened, or rare terrestrial wildlife or plant species?	a. Greater than 0 individuals b. Greater than 0 acres	None	P, O&M	==

Table 4.8-23

Terrestrial Biological Resources Impacts by Component - Discharge

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
8.9.2. Will the discharge component cause loss of individuals of CNPS List 2, 3, or 4 terrestrial plant species?	Greater than 15 percent of known occurrences or populations in Sonoma and Marin counties	None	P, O&M	==
8.9.3. Will the discharge component cause loss of active raptor nest sites?	Greater than 0 active nest sites	None	P, O&M	==
8.9.4. Will the discharge component cause permanent loss of sensitive terrestrial wildlife habitat?	Greater than 25 percent of each habitat type in Sonoma County			
• Russian River		Less than 1%	P	❍
• Laguna		None	P, O&M	==
8.9.5. Will the discharge component cause permanent loss of sensitive native terrestrial plant communities?	Greater than 0 acres			
Russian River		.25 acre	P	⊙
Laguna		None	P, O&M	==
8.9.6. Will the discharge component substantially block or disrupt major terrestrial wildlife migration or travel corridors?	Greater than 0 corridors	None	P, O&M	==
8.9.7. Will the discharge component result in ecological risk to terrestrial plant and wildlife populations (i.e., acute or chronic toxicity and bioaccumulation)?	EQ greater than 10	EQ less than 8.02	O&M	❍

Source: Harland Bartholomew & Associates, Inc., 1996

Notes:
1. Type of Impact:
O&M Operation and Maintenance
P Permanent

2. Level of Significance:
⊙ Significant impact before mitigation; less than significant impact after mitigation
❍ Less than significant impact; no mitigation proposed
== No impact

Impact: **8.9.1-3, 6. Will the discharge component impact terrestrial wildlife or plant species based on evaluation criteria 1 through 3, and 6?**

Analysis: *No Impact; All Alternatives.*

Results of terrestrial habitat assessments, literature review, and coordination with the U.S. Fish and Wildlife Service and the state Department of Fish and Game indicate that the discharge locations:

- do not support endangered, threatened, or rare terrestrial wildlife or plant species or their habitat (criterion #1);
- do not support the California Native Plant Society List 2, 3, or, 4 terrestrial plant species (criterion #2);
- will not impact nesting raptors (criterion #3); and
- will not block major terrestrial wildlife migration or travel corridors (criterion #6).

Measure 2.2.5 avoids sensitive biological resources and establishes procedures for avoidance of construction impacts to terrestrial wildlife or plant species and occupied habitats. Preconstruction surveys will be conducted for sensitive biological resources prior to final Project design. The designated construction zone for the outfall structure will be designed to allow a minimum 30-foot exclusionary buffer for all sensitive plant species and a minimum 100-foot exclusionary buffer for all other sensitive biological resources. Therefore, no impact to terrestrial wildlife or plant species will occur.

During dry winters, discharge to the Russian River may be restricted by low Russian River flows. During these periodic events, wastewater will be provided to farmers outside the normal irrigation season. Water will only be provided to areas currently under evaluation as a component of Alternatives 2 and 3. Other potential contingency measures may be employed but will have no impact. Emergency conservation will involve voluntary conservation measures and result in no impact to terrestrial resources. Similarly, emergency storage and Russian River discharge will utilize existing facilities and not cause any additional impacts to terrestrial resources.

Mitigation: No mitigation is needed.

Impact: **8.9.4. Will the discharge component permanent loss of sensitive terrestrial wildlife habitat?**

Analysis: *Less than Significant; Alternative 5A.*

No special-status terrestrial wildlife species were observed at the site for the discharge outfall structure, but the area supports a well-developed valley foothill riparian woodland directly adjacent to the Russian River. The approximate construction zone boundary associated with this outfall structure is 100 feet by 100 feet (0.25 acres), subsequently, the potential loss of valley foothill riparian habitat will not be greater than 0.25 acres.

The loss of 0.25 acres of valley foothill riparian habitat represents less than a 25 percent loss of this habitat in the region, therefore the impact is less than significant. The loss of this resource is mitigated under Impact 8.9.5.

No Impact; Alternatives 1, 2, 3, 4, and 5B.

Discharge at the Laguna involves no construction.

Mitigation: No mitigation is proposed.

Impact: **8.9.5. Will the discharge component cause permanent loss of sensitive native terrestrial plant communities?**

Analysis: *Significant; Alternative 5A.*

A well-developed mixed riparian woodland occurs along the Russian River, at the location for the discharge outfall structure. The approximate construction zone boundary associated with this outfall structure is 100 feet by 100 feet (0.25 acres), subsequently, the potential loss of riparian woodland will not be greater than 0.25 acres.

Partial avoidance of riparian woodland at the outfall structure location may be possible through implementation of Measure 2.2.5 (Avoid Sensitive Biological Resources). Since complete avoidance of riparian habitat loss will not be possible, the impact will be significant.

No Impact; Alternatives 1, 2, 3, 4, and 5B.

Discharge at the Laguna involves no construction.

Mitigation: *Alternative 5A.*

2.3.11 Sensitive Resource Conservation Program

Alternatives 1, 2, 3, 4, and 5B. No mitigation is needed.

After Mitigation: *Less than Significant after Mitigation; Alternative 5A.*

Loss of riparian habitat will be mitigated by creating new riparian habitat (1 acre created:each acre lost), restoring (1.5 acres restored:each acre lost) or preserving (two acres preserved:each acre lost) riparian habitat of equal function and value.

Impact: **8.9.7. Will the discharge component result in ecological risk to terrestrial plant and wildlife populations (i.e., acute or chronic toxicity and bioaccumulation)?**

Analysis: *Less than Significant; All Alternatives.*

Potential ecological risks were evaluated for a design discharge rate of 20 percent (i.e., highest design discharge rate). In relation to terrestrial biological resources, two transfer pathways were considered for the potential exposure of Russian River and Laguna de Santa Rosa organisms to effluent constituents: water ingestion by wildlife species and exposure by fish consumption by fish-eating birds and mammals (see 4.9-10, Aquatic Biological Resources impacts analysis for discharge for further discussion). EQ for terrestrial exposure to the Russian River discharge ranges from 0.0 to 0.75. EQs for terrestrial exposure to Laguna discharge (in the Laguna) range from 0.0 to 8.02. See Ecological Risk Assessment Report (Parsons Engineering Science, Inc., 1996a) for more details. Ecological quotient values are less than the threshold value of 10 and so the impacts are less than significant.

Mitigation: No mitigation is proposed.

CUMULATIVE IMPACTS

There are six impacts -- either less than significant or significant -- identified in the Terrestrial Biological Resources section:

Impact: **8.2C. Will the Project plus cumulative projects cause loss of individuals of CNPS list 2, 3, or 4 terrestrial plant species?**

Analysis: Alternatives 3A and 3E.

The loss of two populations of hayfield tarplant at the Huntley storage site represents 5percent of the known populations in Sonoma and Marin counties and the loss of one population of bristly linanthus represents 10 percent of the known populations in Sonoma and Marin counties. Both are less than the 15 percent point of significance and therefore are considered less than significant.

Loss of four additional populations of hayfield tarplant or one additional population of bristly linanthus from cumulative projects will result in a significant effect. Though it is unknown if the implementation of the projects identified on the cumulative project list will result in the loss of

four additional populations of these species, it is probable. Both are associated with valley foothill grasslands. Valley foothill grasslands are a common habitat in the region and the site of many projects on the cumulative project lists. Therefore cumulative projects are considered to have a significant effect on both species

Mitigation: 2.4.15. Sensitive Plant Relocation Program. Seeds of hayfield tarplant or bristly linanthus populations shall be collected and reestablished in mitigation sites developed as a result of the Sensitive Resource Conservation Plan.

Impact: 8.3C. Will the Project plus cumulative projects cause loss of active raptor nest sites?

Analysis: Alternative 2 and 3.

Construction and inundation of storage sites may lead to destruction of raptor nests or nest failure, a significant impact. Raptor (hawks, owls, falcons, eagles and vultures) populations have suffered substantial decline over the past century. Many of these species are listed as fully protected or species of special concern by the California Department of Fish and Game and all impacts are considered significant. Project impacts will be fully mitigated through avoidance either through establishment of protective buffers around the nest or modification of construction timing to avoid the nesting season.

Because all impacts from the Project to nesting raptors will be avoided, there are no additive effects to the cumulative projects. No additional mitigation is proposed.

Impact: 8.4C. Will the Project plus cumulative projects cause permanent loss of sensitive terrestrial wildlife habitat?

Analysis: Alternatives 2, 3, 4, and 5A.

The Project will result in less than significant impacts to sensitive wildlife habitat for all alternatives. Losses exceeding 25 percent of existing habitat in the region (Sonoma and Marin counties) are considered significant for this type impact. Pipelines for all alternatives except Laguna Discharge; all reservoir sites; pump stations for all alternatives except Laguna Discharge; geysers steamfield; and the Russian River discharge outfall will result in a loss of sensitive wildlife habitats (annual grassland, coastal scrub, coastal oak woodland, montane hardwood, valley foothill riparian). Most of these habitats are also considered sensitive plant communities, and all impacts on sensitive plant communities are significant and will be fully mitigated. However, two wildlife habitat types, annual grassland and coastal scrub, are not sensitive plant communities, so loss of these habitats is not fully mitigated.

Losses of annual grassland and coastal scrub occur from pump stations (less than eight acres) and from conversion of habitat to crop production which is less suitable for wildlife habitat. The largest loss of annual grassland will occur with implementation of Alternative 3D (21 percent of the estimated 16,884 acres in Sonoma and Marin counties). The largest loss of coastal scrub will occur with implementation of Alternative 3C (less than 0.01 percent of the estimated 249,820 acres in Sonoma and Marin counties). Mitigation for losses to coastal scrub and annual grassland are not proposed.

Many of the projects identified on the cumulative project list will result in small incremental (but unknown) losses to both annual grassland and coastal scrub. The projects most likely to result in large losses to these habitats are reclamation projects. Additional agricultural irrigation with reclaimed water is planned for Petaluma (2,075 acres), Windsor (745 acres), the Airport (unknown), Camp Meeker (unknown), Forestville (unknown), Graton (unknown), Occidental (unknown), and the Russian River Sanitation District (200-400 acres). Habitat types potentially affected by the cumulative projects are unknown but assumed to be similar to those of the Project. Implementation of these projects in conjunction with the Project will not result in greater than 25 percent loss of coastal scrub (62,455 acres) in the region. Implementation of any of these projects in conjunction with the Project may result in significant losses to the region's annual grassland. Total cumulative loss to the annual grassland of all cumulative projects potentially exceeds 40 percent. This is a significant cumulative impact.

Mitigation: No feasible mitigation has been identified.

Impact: 8.5C. Will the Project plus cumulative projects cause permanent loss of sensitive native terrestrial plant communities?

Analysis: Alternatives 2, 3, and 5A.

Any loss of sensitive native terrestrial plant communities is considered significant in this analysis. All reservoir sites are associated with some loss of sensitive plant communities (oak woodland, riparian woodland, and native grassland). All losses to sensitive native plant communities acreage and functions will be fully mitigated through habitat creation, restoration and preservation.

Though cumulative projects may result in the loss of these communities, there will be no net loss for the Project and therefore the effects of the Project are not additive. No change in significance or mitigation of the Project is proposed.

Impact: **8.7C. Will the Project plus cumulative projects result in ecological risk to terrestrial plant and wildlife populations (i.e., acute or chronic toxidity and bioaccumulation)?**

Analysis: Alternatives 1, 2, 3, and 5.

Exposure at Storage Sites and Irrigation Systems

There are less than significant impacts (EQ less than or equal to 10) associated with the operation of storage sites and irrigation systems (EQ ranging from 0.00 to 0.01).

The list of cumulative projects includes new storage sites for the City of Healdsburg, the City of Petaluma, the Sonoma County Airport, and the City of Santa Rosa for Gallo properties near Cotati (an interim project). Additional acreage to receive wastewater for irrigation is planned for the Petaluma, Windsor, Airport, Camp Meeker, Forestville, Graton and Occidental Treatment Plants and the Russian River Sanitation District. Because the ecological risk assessment at storage reservoirs and agricultural irrigation sites assumed 100 percent exposure to reclaimed water, nearby cumulative projects could not supply additional exposure for terrestrial species. No significant cumulative impacts are identified.

Exposure in the Russian River or the Laguna

Less than significant ecological risk to terrestrial wildlife and plants will occur due to alternatives 2, 3, 4, and 5A scenario result in EQs ranging below 1 (cumulative EQ less than 0.75). Though potential future discharge systems are planned for the Russian River (see Water Quality Section), future dischargers must adhere to a regulatory limit of zero acute and chronic toxicity in their discharge. Adherence to these standards will ensure that water quality of the Russian River will not decrease 13 fold, resulting in EQs greater than 10. Therefore the additive effect of the Project to the cumulative projects is less than significant. No mitigation is proposed.

Discharge for alternatives 1 and 5B via the Laguna de Santa Rosa will result in EQs ranging from 0.00 than 8.02 (great blue heron). Additional discharge from cumulative projects may occur in the Laguna, both in wastewater discharge and stormwater run-off events. It is possible the future water quality of the Laguna may produce significant ecological risk for the great blue heron. This cumulative impact is considered significant. A large portion of the cumulative EQ for the great blue heron is associated with aluminum (EQ=3.2).

Mitigation: 2.4.16. Ecological Risk Monitoring and Source Control Program. A monitoring plan shall be undertaken to collect additional toxicity data (Kelley Ponds, Russian River) over a two-year period. The data shall be used in an ecological risk assessment to determine if the existing system, the Project, and cumulative project discharges will result in an EQ exceeding 10 for great blue heron in the Laguna. If it is determined that the EQ for great blue heron exceeds 10, then the City shall undertake a program to identify the source and reduce the cumulative EQ for aluminum to less than 3.2.

Aluminum in effluent is derived primarily from the addition of alum sulfate to wastewater during treatment to enhance solids removal and disinfection. Options for reducing aluminum in effluent include substituting ferric chloride or an organic polymer during treatment and identifying primary sources (aside from treatment) and implementing a control program.

SUMMARY OF SIGNIFICANT IMPACTS AND MITIGATION MEASURES

Table 4.8-24

Summary of Significant Impacts and Mitigation Measures -Terrestrial Biological Resources

Impact	Level of Significance	Mitigation Measure
Storage Reservoir		
8.5.3. Storage reservoir component may cause loss of active raptor nest sites.	Alt 2 - ⊙ Alt 3 - ⊙	2.4.5. Active Raptor Nest Location and Monitoring Program
8.5.5. Storage reservoir component may cause loss of sensitive native terrestrial plant communities.	Alt 2 - ⊙ Alt 3 - ⊙	2.3.11. Sensitive Resource Conservation Program
Discharge		
8.9.5. Discharge component may cause permanent loss of sensitive native terrestrial plant communities.	Alt 5A - ⊙	2.3.11. Sensitive Resource Conservation Program
Cumulative Impacts		
8.2C. Will the Project plus cumulative projects casue a loss of individuals of CNPS List 2, 3, or 4 terrestrial plant species?	Alt 3A - ⊙ Alt 3E - ⊙	2.4.15. Sensitive Plant Relocation Program
8.4C. Will the Project plus cumulative projects cause a permanent loss of senstive terrestrial wildlife habitat?	Alt 2 - ● Alt 3 - ●	No feasible mitigation has been identified.
8.7C. Will the Project plus cumulative projects result in ecological risk to terrestrial plant and wildlife populations (i.e., acute or chronic toxicity and bioaccumualtion)?	Alt 1 - ● Alt 5B - ⊙	2.4.16. Ecological Risk Monitoring and Source Control Program.

Source: Harland Bartholomew & Associates, Inc., 1996

Notes:
1. Type of Impact:
● Significant impact before and after mitigation

2. Level of Significance:
⊙ Significant impact before mitigation; less than significant impact after mitigation

SUMMARY OF IMPACTS BY ALTERNATIVE

Table 4.8-25

Summary of Impacts by Alternative -Terrestrial Biological Resources

Component	Alt 1	Alt 2A	Alt 2B	Alt 2C	Alt 2D	Alt 3A	Alt 3B	Alt 3C	Alt 3D	Alt 3E	Alt 4	Alt 5A	Alt 5B
No Project Alternative	○	--	--	--	--	--	--	--	--	--	--	--	--
Headworks Expansion	--	==	==	==	==	==	==	==	==	==	==	==	==
Urban Irrigation	--	==	==	==	==	==	==	==	==	==	--	--	--
Pipelines	--	==	==	==	==	==	==	==	==	==	==	==	--
Storage Reservoirs	--	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	--	--	--
Pump Stations	--	○	○	○	○	○	○	○	○	○	○	--	--
Agricultural Irrigation	--	○	○	○	○	○	○	○	○	○	--	--	--
Geysers Steamfield	--	--	--	--	--	--	--	--	--	--	○	--	--
Discharge	--	○	○	○	○	○	○	○	○	○	○	⊙	○
Cumulative	●	●	●	●	●	●	●	●	●	●	==	==	⊙

Source: Harland Bartholomew & Associates, Inc., 1996

-- Not applicable
○ Less than significant impact; no mitigation proposed
== No impact
● Significant impact before and after mitigation
⊙ Significant impact; less than significant after mitigation

PREPARERS, REFERENCES, AND CONSULTATION AND COORDINATION

Preparers

Kevin Gusé, Harland Bartholomew & Associates, Inc.
Joyce Hunting, Harland Bartholomew & Associates, Inc.
Wirt Lanning, Harland Bartholomew & Associates, Inc.

Reviewers

Michael Bumgardner, Harland Bartholomew & Associates, Inc.
Patricia I. Collins, Harland Bartholomew & Associates, Inc.
Robin Cort, Ph.D., Parsons Engineering Science, Inc.
Anders J. Hauge, Harland Bartholomew & Associates, Inc.
John Cummings, Ph.D., Peer Review Committee
David Ziegler, Peer Review Committee

References

HBA Team Documents

Harland Bartholomew & Associates, Inc. 1996a. *Biological Resources, Volume 1.* July. (Appendix K-1).

Harland Bartholomew & Associates, Inc. 1996b. *Biological Resources, Volume 2.* July. (Appendix K-2).

Harland Bartholomew & Associates, Inc. 1996c. *Biological Resource, Volume 4A.* (Appendix K-5).

Harland Bartholomew & Associates, Inc. 1996d. *Biological Resource, Volume 4B.* (Appendix K-5).

Harland Bartholomew & Associates, Inc. 1996e. *Biological Resource, Volume 4C.* (Appendix K-5).

Harland Bartholomew & Associates, Inc. 1996f. *Biological Resource, Volume 4D.* (Appendix K-5).

Harland Bartholomew & Associates, Inc. 1996g. *Biological Resource, Volume 4E.* (Appendix K-5).

Sycamore Environmental Consultants, Inc. 1996. *Biological Resources, Technical Memorandum Volume 3.* July. (Appendix K-3).

Parsons Engineering Science, Inc. 1996. *Ecological Risk Assessment.* (Appendix K-4).

Other References

Allan, P. F. 1950. Ecological basis for land use planning in Gulf Coast marshlands, Journal of Soil and Water Conservation 5:57 *in* Lewis, III., R. R. (ed.). *Creation and Restoration of Coastal Plant Communities*. CRC Press, Boca Raton, FL.

Anderson, J. R., E. E. Hardy, J. T. Roach, and R. T. Witmer. 1976. A Land Use and Land Cover Classification System for Use with Remote Sensor Data. U. S. Department of the Interior, Geological Survey, Professional Paper 64.

Association of Bay Area Governments. 1991. Status and trends report wetlands and related habitats. Third draft report, San Francisco Estuary Project, United States Environmental Protection Agency, San Francisco, California.

Bailey, R. G. 1982. Classification systems for habitat and ecosystems. Pages 16-26, *in* Mason, W. T., Jr. and S. Iker (eds.), *Research on Fish and Wildlife Habitat*. Office of Research and Development, United States Environmental Protection Agency, Washington, D. C.

Bakker, E. 1971. *An Island Called California, An Ecological Introduction to its Natural Communities*. University of California Press, Berkeley, CA.

Barry, W. J. 1972. *The Central Valley Prairie, Volume I. California Prairie Ecosystem*. California Department of Parks and Recreation.

Bartel, J. 1993. Cupressaceae family. *in* Hickman (editor), *The Jepson Manual, Higher Plants of California*. University of California Press, Berkeley.

Burridge, B. 1995. Sonoma County Breeding Bird Atlas. Madrone Audubon Society, Santa Rosa, California.

California Department of Fish and Game. 1995. California Natural Diversity Data Base record search conducted on March 15, 1995.

Cheatham, N. H., and J. R. Haller. 1975. An Annotated List of California Habitat Types. University of California, Natural Land and Water Reserves System, Berkeley, California.

Connors, P. G., and J. L. Maron. 1989. Estero Americano Bird Population Study. Long-Term Detailed Wastewater Reclamation Studies Santa Rosa Subregional Water Reclamation System Technical Memorandum No. E13.

EPA. 1989. Risk Assessment Guidance for Superfund, Vol. II Environmental Evaluation Manual. Interim Final. USEPA, EPA/54011-89/001.

George, M. R., J. Clawson, B. Weitkamp, and B. Willoughby. 1980. Management of Small Pastures. University of California, Division of Agricultural Sciences, Leaflet 2906.

Grenfell, Jr., W. E. 1988. Valley-foothill riparian. Pages 86-87, *in* Mayer, K. and W. Laudenslayer Jr. (eds.), *A Guide to Wildlife Habitats of California*. California Department of Forestry and Fire Protection, Sacramento, CA.

Griffin, J. R. 1977. Oak woodland. Pages 383-415, *in* M. G. Barbour and J. Major, eds. *Terrestrial Vegetation of California*. John Wiley and Sons, New York.

Hanes, T. L. 1977. California chaparral. Pages 417-469 *in* Barbour, M., and J. Major (eds.), *Terrestrial Vegetation of California*. John Wiley and Sons, New York, NY.

Harrison, A., E. Small, and H. Mooney. 1971. Drought relationships and distribution of two Mediterranean climate Californian plant communities. Ecology 52:869-875 *in* Mayer, K. and W. Laudenslayer Jr. (eds.). *A Guide to Wildlife Habitats of California*. California Department of Forestry and Fire Protection, Sacramento, CA.

Holland, R. 1986. Preliminary descriptions of the terrestrial natural communities of California. California Department of Fish and Game, Sacramento, CA.

Jones & Stokes Associates, Inc. 1981. *Ecological Characterization of the Central and Northern California Coastal Region, Volume II, Part 1, Regional Characterization*. Prepared by Jones & Stokes Associates, Inc. for the United States Fish and Wildlife Service, Region 1, Portland, OR.

Kie, J. G. 1988. Annual grassland. Pages 118-119, *in* Mayer, K. and W. Laudenslayer Jr., (eds.). *A Guide to Wildlife Habitats of California*. California Department of Forestry and Fire Protection, Sacramento, CA.

Kozloff, E. N., and L. H. Beidleman. 1994. *Plants of the San Francisco Bay Region, Mendocino to Monterey*. Sagen Press, Pacific Grove, CA.

Madrone Associates. 1977. The natural resources of Esteros Americano and de San Antonio. California Department of Fish and Game, Sacramento, CA.

Mayer, K. E., and W. F. Laudenslayer, Jr. (editors). 1988. *A Guide to Wildlife Habitats of California*. California Department of Forestry and Fire Protection, Sacramento, CA.

McMinn, H. and E. Maino. 1981. *Pacific Coast Trees*. University of California Press, Berkeley.

Marcus, L., and J. Vilms. 1989. Sonoma Baylands Enhancement Plan. California State Coastal Conservancy, Sonoma Land Trust.

Menzie, C., J. Cura, J. Freshman, and S. Svirsky. 1993. Evaluating ecological risks and developing remedial objectives at forested wetland systems in New England. Pp. 89-100 in *Application of Ecological Risk Assessment to Hazardous Waste Site Remediation.* Workshop Proceedings. USEPA Science Advisory Board.

Munz, P. A. 1964. *California Flora and Supplement.* University of California Press, Berkeley, California.

Ornduff, R. 1974. *An Introduction to California Plant Life.* University of California Press, Berkeley, CA.

Pavlik, B. M., P. C. Muick, S. Johnson, and M. Popper. 1991. *Oaks of California.* Cachuma Press, Los Olivos, CA.

Schoenherr, A. A. 1992. *A Natural History of California.* University of California Press, Berkeley, CA.

Schultze, R. F. 1988. Orchard-Vineyard. Pages 140-141, *in* Mayer, K. and W. Laudenslayer Jr. (eds.). *A Guide to Wildlife Habitats of California.* California Department of Forestry and Fire Protection, Sacramento, CA.

Showers, D. W. 1994. Fish and Game Code Section 2081 Management Authorizations. California Department of Fish and Game, Environmental Service Division.

Shuford, W. D., and I.C. Timossi. 1989. *Plant Communities of Marin County.* California Native Plant Society, Sausalito, CA.

Skinner, M. W., and B. M. Pavlik (eds.). 1994. *Inventory of Rare and Endangered Vascular Plants of California, Fifth Edition.* California Native Plant Society, Sacramento, CA.

United States Fish and Wildlife Service. 1981. Pacific Coast ecological inventory, Santa Rosa, California.

Watkin, G.E., and M.E. Stelljes. A Proposed Approach to Quantitatively Assess Potential Ecological Impacts to Terrestrial Receptors from Chemical Exposure, *Environmental Toxicology and Risk Assessment: 2nd Volume, STP 1216,* J.W. Gorsuch, F.J. Dwyer, C.G. Ingersoll, and T. W. La Point, eds., American Society for Testing and Materials, Philadelphia, 1993.

Williams, R. D., N. L. Crane, J. R. Smith, and E. H. Yeoman. 1982. The Geysers Unit 20 Leasehold and Site Specific Environmental Description and Impact

Assessment: Terrestrial Ecology. Pacific Gas and Electric Company, Department of Engineering Research, Report 411-81.356.

Zeiner, D. C. 1988. Cropland. Pages 138-139, *in* Mayer, K. and W. Laudenslayer Jr. (eds.). *A Guide to Wildlife Habitats of California.* California Department of Forestry and Fire Protection, Sacramento, CA.

Zinke, P. 1977. The redwood forest and associated North Coast forests. Pages 679-698, *in* Barbour, M. and J. Major (editors), *Terrestrial Vegetation of California.* John Wiley and Sons, New York, New York.

Consultation and Coordination

Persons Contacted

N/A	Marin County Agricultural Commission
N/A	California Department of Water Resources
N/A	Sonoma County Farmlands Group
Pat Balderama	Marin County Planning Department
David Bannister	Sierra Club
Bob Barnes	National Audubon Society - Sacramento
Caitlin Bean	California Department of Fish and Game, Region 3 (Yountville)
Fred Bottie	California Department of Fish and Game, Region 3 (Yountville)
Marsha Brockbank	San Francisco Bay Estuary Project
Betty Burridge	Sonoma County Breeding Bird Atlas Administrator
Jim Bybee	National Marine Fisheries Service
Michael Carlan	San Francisco Regional Water Quality Control Board
Richard Charter	Sonoma County Land Trust
Bill Cox	California Department of Fish and Game Region 3 (Yountville)
Dennis Dorch	Cotati Planning Department
Rich Estabrook	Bureau of Land Management
Dan Evans	Point Reyes Bird Observatory

Gary Fellers	Point Reyes National Seashore
Steve Ford	California Water Commission (Central District) - Biologist
Joe Gaffney	Rohnert Park Community Development Department
Bob Gaiser	Sonoma County Permit and Resource Management Department
Barry Garrison	CDFG - Hardwoods Coordinator
Jesse Grantham	National Audubon Society (Sanctuaries)
Betty Guggolz	California Native Plant Society
David Hanson	Sonoma County Agricultural Preservation and Open Space District
Ann Howald	California Department of Fish and Game, Region 3 (Yountville)
Jeff Jensen	San Francisco Bay Conservation and Development Commission (BCDC)
Ron Keith	Mosquito Abatement District (Marin and Sonoma County)
Jan Knight	United States Fish and Wildlife Service
Joe Le Claire	San Francisco Bay Conservation and Development Commission (BCDC)
Kathryn Lodato	California Native Plant Society
Laurel Marcus	State Coastal Conservancy
Dave Mattens	National Marine Fisheries Service, Santa Rosa
Darlene McGriff	California Department of Fish and Game, Natural Heritage Division, Sacramento
Carolyn McLain	University of California Cooperative Extension, Sonoma County
Ed Morris	California Water Commission
Phil Northen	Sonoma State University (Herpetologist)
Ruth Pratt	United States Fish and Wildlife Service
Dave Plummer	State Lands Commission
Chuck Quibell, Ph.D.	Sonoma State University - Professor of Botany

Eric Ruhlen	Institute for Bird Population Studies
Ceil Scandone	Association of Bay Area Governments
Lisa Shanks	National Resource Conservation Service
Steve Sharp	California Association of Local Agency Formation Commission
Ken Stelling	Division of Oil and Gas
Kristin Tarp	United States Fish and Wildlife Service, Sacramento
William Travis	San Francisco Bay Conservation and Development Commission (BCDC)
Ed Ueber	National Oceanic and Atmospheric Administration
Bill Van Beckum	California Coastal Commission
Tuck Vath	State Water Resources Control Board
Robert Verner	Marin Agricultural Land Trust
Allison Willy	United States Fish and Wildlife Service, Sacramento
Larry Wycoff	California Department of Fish and Game, Sacramento
Kurt Yeiter	Petaluma Planning Department
Rick York	California Energy Commission

Correspondence

None.

TABLE OF CONTENTS

LIST OF TABLES

4.9 AQUATIC BIOLOGICAL RESOURCES

This section discusses Project impacts on aquatic biological resources within the areas of direct impact, which are the construction zones of the Project components, as well as on a broader, regional scale. The potential for loss of special status (endangered, threatened, rare or protected) species associated with aquatic habitats is evaluated, as is the potential for loss of sensitive aquatic habitat, such as freshwater or brackish marsh, vernal pools, streams, or ponds. The potential for change in aquatic habitat in the Gulf of the Farallones National Marines Sanctuary and ecological risk to aquatic resources from toxicity or bioaccumulation are discussed. To provide a basis for this evaluation, aquatic biological resources are described in terms of aquatic communities, including estuaries, rivers, and streams, and other freshwater communities such as marshes, ponds, and vernal pools. Special status aquatic species which potentially occur in the Project area are identified, along with their status and typical habitat.

IMPACTS EVALUATED IN OTHER SECTIONS

The following impacts associated with Aquatic Biological Resources are not evaluated in this section but are cross-referenced here to direct the reader to the sections where the impacts are addressed.

- Alteration of Surface Water Quality. Construction and operation of irrigation systems, storage reservoirs, and discharge into the Russian River may affect existing water quality in streams, ponds, and other bodies of water. The potential ecological risk to organisms due to Project implementation is discussed in this section. Other water quality issues are discussed in Section 4.6, Surface Water Quality.

- Submerged and Emergent Aquatic Plants. Impacts on these aquatic plants, for example algae and water primrose are evaluated as part of Section 4.6, Surface Water Quality.

- Jurisdictional Wetlands. Impacts caused by the discharge of dredge and fill material into jurisdictional wetlands are discussed in Section 4.10, Jurisdictional Wetlands Resources.

- Soil Erosion. Impacts due to erosion and sedimentation are discussed in Section 4.3, Geology, Soils, and Seismicity for construction impacts and Section 4.2, Agriculture for impacts of irrigation.

- Upland Plant and Wildlife Communities. Impacts to upland plant and wildlife communities are discussed in Section 4.8, Terrestrial Biological Resources.

AFFECTED ENVIRONMENT (SETTING)

The Project alternatives are located in a region that supports an abundance of diverse aquatic ecosystems. The aquatic ecosystems within the Area of Direct Impacts (for definition and map, see Affected Environment of Terrestrial Biological Resources, Section 4.8) could be directly affected by the construction and operation of the Project components. These same actions could indirectly affect aquatic biological resources on a broader, regional scale (i.e., within the Area of Indirect Impacts).

Various public and private natural resource planning efforts are underway that provide for the conservation and regulation of aquatic biological resources, both within the Area of Indirect Impacts and Area of Direct Impacts. Existing and future plans for these resources could be affected by the Project alternatives.

Regional Aquatic Biological Resources

Southern Region

The Area of Indirect Impacts within Sonoma and northern Marin counties encompasses a variety of aquatic ecosystems. In the southern region, representative aquatic ecosystems include San Pablo Bay (a northern extension of San Francisco Bay) and several small estuaries and drainages that enter San Pablo Bay, including Petaluma River, Tolay Creek, Sonoma Creek, and Napa Slough. In addition, the tidal wetlands associated with San Pablo Bay, in combination with the large salt marsh surrounding the Petaluma River, form the second largest contiguous wetland in the San Francisco Bay Area (after Suisun Marsh).

Western Region

In the western region of Sonoma and Marin counties, coastal aquatic ecosystems include Lagunitas Creek and Walker Creek (entering Tomales Bay); the Estero de San Antonio and its associated Stemple Creek drainage; the Estero Americano and its associated Americano Creek drainage; Bodega Bay; Salmon Creek; and the Russian River and its associated estuary. The Russian River is the largest drainage in the region.

A variety of factors including historical and current development have reduced the abundance and diversity of the aquatic resources associated with the major aquatic ecosystems in the region, leading to the protection or the proposed protection of several species (i.e., special-status species). Lists of special-status species potentially occurring in the region were provided by California Department and Fish and Game, National Marine Fisheries Sanctuary, and United States Fish and Wildlife Service. Additional information regarding special-status species was obtained from the California Native Plant Society and Madrone Audubon Society. The comprehensive special-status plant and wildlife lists generated by this process

include 182 plant species and 102 wildlife species. Professional judgment of HBA Project team biologists and coordination with resource experts resulted in a reduced number of special-status species, those deemed most likely to occur within the Project area. An explanation of the screening process and consolidated lists of special-status plant and wildlife are provided in the *Biological Resources, Volume 2* (Harland Bartholomew & Associates, Inc. 1996b).

Approximately 50 special-status aquatic plant and wildlife species have been identified as potentially occurring in the Area of Indirect Impacts and consequently are evaluated in this EIR/EIS (Table 4.9-1).

The aquatic biological resources of Sonoma and Marin counties within the Area of Indirect Impacts are described below and are identified in association with the dominant plant communities and wildlife habitats. The acreages of each aquatic plant community and associated aquatic wildlife habitat identified within the Area of Indirect Impacts are presented in the Environmental Consequences (Impacts) and Recommended Mitigation section.

Aquatic Communities

The following section provides a brief discussion of the structure and function of various aquatic plant and wildlife resources within the Area of Indirect Impacts. Aquatic plant communities and their corresponding California Statewide Wildlife Habitat Relationship System (CWHR) wildlife habitat types in parentheses are described below and in Table 4.9-2.

Table 4.9-1

Special-Status Species Associated with Aquatic Habitats

	Status				Management Concerns	
Species	State[1]	Federal[1]	CNPS[1]	Source	Habitat	Potential Threats
Plants						
Alopecurus aequalis var. *sonomensis* Sonoma alopecurus	--	FPE	1B	2,3,5,10	Freshwater marsh, riparian scrub, and wet meadow.	Grazing and wetland habitat loss.
Astragalus tener var. *tener* Alkali milk-vetch	--	--	4	6	Valley grasslands (adobe clay), alkali flats, and vernally moist meadows.	Grazing, agriculture, and urbanization.
Blennosperma bakeri Sonoma sunshine	SE	FE	1B	2,3,5	Found in association with vernal pools, wet grasslands, and drainage swells.	Urbanization, grazing, and agriculture.
Calamagrostis bolanderi Bolander's reed grass	--	--	4	6	Freshwater marsh, coastal scrub, bogs, moist meadows, and open woodlands.	Unknown.
Calamagrostis crassiglumis Thurber's reed grass	--	--	2	2,5	Coastal scrub (mesic) and freshwater marsh.	Grazing.
Campanula californica Swamp harebell	--	--	1B	2,3,5	Bog/fen, freshwater marsh, north coast coniferous forest, closed-cone coniferous forest, and coastal marshy areas.	Grazing, development, and marsh habitat loss.
Carex albida White sedge	SE	FPE	1B	2,3,5,10	Freshwater marsh. Believed to be limited to a single population at Pitkin Marsh.	Wetland drainage and spraying of chemical effluents.
Carex californica California sedge	--	--	2	8	Meadows drier areas of swamps.	Unknown.
Carex comosa Bristly sedge	--	--	2	6	Lake margins and wet places.	Marsh drainage.

Notes at end of table.

Table 4.9-1

Special-Status Species Associated with Aquatic Habitats

Species	Status				Management Concerns	
	State[1]	Federal[1]	CNPS[1]	Source	Habitat	Potential Threats
Castilleja uliginosa Pitkin Marsh Indian paintbrush	SE	--	1A	2,3,5,7	Freshwater marsh and moist places.	Grazing, development, and marsh habitat loss.
Cordylanthus maritimus ssp. *palustris* Point Reyes bird's-beak	--	--	1B	2,3,5	Coastal salt marsh.	Development, foot traffic, non-native plants, and altered hydrology.
Cordylanthus mollis ssp. *mollis* Soft bird's-beak	SR	FPE	1B	2,3,5,7	Coastal salt marsh	Development, foot traffic, non-native plants, and altered hydrology.
Dichanthelium lanuginosum var. *thermale* *[Panicum acuminatum* var. *acuminatum]* Geysers dichanthelium [panicum]	SCE	--	1B	8	Meadows and seeps in the vicinity of hot springs, marshes, and streambanks.	Energy development.
Downingia pusilla Dwarf downingia	--	--	2	3	Valley-foothill grasslands (mesic), vernal pools, and roadside ditches.	Urbanization, agriculture, grazing, and off-road vehicles.
Eleocharis parvula Small spikerush	--	--	4	6	Coastal salt marsh.	Unknown.
Grindelia stricta var. *angustifolia* Marsh gumplant	--	--	4	8	Coastal salt marsh and tidal areas.	Unknown.
Helianthus exilis Serpentine sunflower	--	--	4	8	Seeps in cismontane woodland and chaparral with serpentine soils.	Unknown.
Lasthenia burkei Burke's goldfields	SE	FE	1B	2,3,5	Vernal pools and wet meadows.	Agriculture, urbanization and grazing.

Notes at end of table.

Table 4.9-1

Special-Status Species Associated with Aquatic Habitats

Species	Status				Management Concerns	
	State[1]	Federal[1]	CNPS[1]	Source	Habitat	Potential Threats
Lathyrus jepsonii var. *jepsonii* Delta tule pea	--	--	1B	9	Brackish and freshwater marsh, coastal and estuarine marshes.	Agriculture and water diversions.
Legenere limosa Legenere	--	--	1B	2,3,5,7	Vernal pools and sloughs. Occurs in pools with *Downingia pusilla.*	Grazing and development.
Lilaeopsis masonii Mason's lilaeopsis	SR	--	1B	9	Brackish or freshwater marsh, riparian scrub, and intertidal streambanks.	Development, flood control, recreation, erosion, and agriculture.
Lilium maritimum Coast lily	--	--	1B	2,5,6	Coastal scrub, coastal prairie, bogs, broad-leaved upland forest, and gaps in coniferous forest.	Road maintenance, urbanization, and horticultural collecting.
Lilium pardalinum ssp. *pitkinense [L. pitkinense]* Pitkin Marsh lily	SE	FPE	1B	2,3,5,10	Freshwater marsh and valley-oak scrub. Endemic to Vine Hill area.	Marsh habitat loss, horticultural collection, and grazing.
Limnanthes douglasii ssp. *sulphurea* Point Reyes meadowfoam	SE	--	1B	2,5	Vernal pools, freshwater marsh, and wet meadows of coastal prairies.	Grazing, trampling, and non-native plants.
Limnanthes vinculans Sebastopol meadowfoam	SE	FE	1B	2,3,5	Vernal pools and wet meadows. Endemic to Sonoma County.	Urbanization, agriculture, and grazing.
Navarretia leucocephala ssp. *bakeri* Baker's navarretia	--	--	1B	3	Vernal pools, valley-foothill grasslands, cismontane woodland, and mesic meadows.	Unknown.

Notes at end of table.

Table 4.9-1

Special-Status Species Associated with Aquatic Habitats

	Status				Management Concerns	
Species	**State[1]**	**Federal[1]**	**CNPS[1]**	**Source**	**Habitat**	**Potential Threats**
Navarretia leucocephala ssp. *plieantha [N. plieantha]* Many-flowered navarretia	SE	FPE	1B	2,3,5	Vernal pools.	Grazing, development, and off-road vehicles.
Plagiobothrys glaber Hairless popcorn-flower	--	--	1A	2	Wet alkaline soils in valleys and coastal salt marshes.	Grazing and development.
Plagiobothrys mollis var. *vestitus* Petaluma popcorn-flower	--	--	1A	2,3,5,7	Wet sites in valley-foothill grassland.	Draining and development of marshes.
Pleuropogon hooverianus North Coast semaphore grass	SR	--	1B	2,3,5	Broad-leaved, upland forests and meadows; vernal pools; marshes; and redwood forests.	Unknown.
Pogogyne douglasii ssp. *parviflora [P. douglasii]* Douglas pogogyne	--	--	3	8	Chaparral with serpentine soils, valley-foothill grasslands, vernal freshwater marshes, and vernal pools.	Urbanization and agriculture.
Polygonum marinense Marin knotweed	--	--	3	2,3,5	Coastal saltmarsh.	Coastal development.
Potentilla hickmanii Hickman's cinquefoil	SE	FPE	1B	2,3,5,7	Vernally wet meadows and open pine forests.	Urbanization and recreational activities.
Ranunculus lobbii Lobb's aquatic buttercup	--	--	4	6	Shallow water, vernal pools, valley and foothill grassland, oak woodland, and mixed forest.	Urbanization and agriculture.

Notes at end of table.

Table 4.9-1

Special-Status Species Associated with Aquatic Habitats

	Status				Management Concerns	
Species	State[1]	Federal[1]	CNPS[1]	Source	Habitat	Potential Threats
Rhynchospora alba White beaked-rush	--	--	4	6	Freshwater marsh.	Unknown.
Rhynchospora californica California beaked-rush	--	--	1B	2,3,5	Meadows, freshwater marshes, seeps, and bogs.	Marsh habitat loss.
Rhynchospora globularis var. *globularis* Round-headed beaked-rush	--	--	2		Freshwater marsh.	Marsh habitat loss.
Sidalcea calycosa ssp. *rhizomata* Point Reyes checkerbloom	--	--	1B	8	Marshes near coast.	Unknown.
Sidalcea oregana ssp. *valida* Kenwood Marsh checkerbloom	SE	FPE	1B	2,3,5,10	Freshwater marsh.	Grazing and habitat alteration.
Suaeda californica California seablite	--	FPE	1B	2,5	Coastal salt marsh	Recreation, erosion, and alteration of marsh habitat. Development, foot traffic, non-native plants, and altered hydrology.
INVERTEBRATES						
Branchinecta conservatio Conservancy fairy shrimp	--	FE	--	1	Valley-foothill grasslands in vernal pools.	Habitat destruction due to agricultural and urban development.
Branchinecta longiantennae Longhorn fairy shrimp	--	FE	--	1	Valley-foothill grasslands in vernal pools.	Habitat destruction due to agricultural and urban development.

Notes at end of table.

Table 4.9-1

Special-Status Species Associated with Aquatic Habitats

	Status				Management Concerns	
Species	**State[1]**	**Federal[1]**	**CNPS[1]**	**Source**	**Habitat**	**Potential Threats**
Branchinecta lynchi Vernal pool fairy shrimp	--	FT	--	1	Valley-foothill grasslands in vernal pools.	Habitat destruction due to agricultural and urban development.
Lepidurus packardi Vernal pool tadpole shrimp	--	FE	--	1	Valley-foothill grasslands in vernal pools.	Habitat loss and degradation.
Syncaris pacifica California freshwater shrimp	SE	FE	--	2,3,5	Suitable habitat in streams with riparian tree coyer and submerged roots and branches along undercut banks.	Degradation of water quality, loss of annual stream flow, and introduction of exotic predatory fish.
FISH						
Eucyclogobius newberryi Tidewater goby	SSC	FE	--	2,3,5	Brackish water habitats. Still, but not stagnant, water.	Degradation of habitat and water quality, and changes in flow and salinity.
Hypomesus transpacificus Delta smelt	ST	FT	--	7	Confined to the upper Sacramento-San Joaquin River estuary in shallow waters near the entrapment zone.	Degradation of water quality, and changes in flow and salinity.
Hysterocarpus traskii pomo Russian River tule perch	SSC	--	--	3,5	Confined to the Russian River and its tributaries.	Degradation of water quality and habitat.
Lampetra ayresi River lamprey	SSC	--	--	7	Coastal streams and rivers from San Francisco north.	Degradation of habitat and water quality and changes in flow regimes.

Notes at end of table.

Table 4.9-1

Special-Status Species Associated with Aquatic Habitats

Species	Status				Management Concerns	
	State[1]	Federal[1]	CNPS[1]	Source	Habitat	Potential Threats
Lavinia symmetricus navarroensis Navarro roach	SSC	--	--	2,5	Slower, warmer reaches of streams in the Russian and Navarro River drainages.	Degradation of water quality, changes in flow regimes, and competition from introduced species.
Mylopharodon conocephalus Hardhead	SSC	--	--	1	Large pools with little silt in the Sacramento-San Joaquin and Russian River systems.	Competition from introduced centrarchids and habitat loss.
Oncorhynchus kisutch Coho salmon	SSC	FPT	--	7	Most coastal streams and rivers from San Lorenzo Creek in Santa Cruz County north.	Damming, agricultural development, logging, overfishing, and improper watershed management.
Pogonichthys macrolepidotus Splittail	SE	FPT	--	2,5	Backwater slough areas in the lower Delta, San Pablo Bay, and Petaluma River.	Habitat loss, degradation of water quality, and changes in flow regimes.
Spirinchus thaleichthys Longfin smelt	SSC	--	--	2,5	Prefers moderately saline waters in major bays and estuaries from San Francisco Bay northward.	Degradation of water quality and changes in flow regimes.
AMPHIBIANS						
Ambystoma californiense California tiger salamander	SSC	FC	--	2,4,5	Oak savannah, valley-foothill grasslands, and vernal pools.	Habitat destruction due to agricultural and urban development.

Notes at end of table.

Table 4.9-1

Special-Status Species Associated with Aquatic Habitats

Species	Status				Management Concerns	
	State[1]	Federal[1]	CNPS[1]	Source	Habitat	Potential Threats
Rana aurora draytoni California red-legged frog[8]	SSC	FT	--	2,3,4,5, 7	Marshes, streams, lakes, reservoirs, and ponds in foothills and grasslands.	Habitat destruction due to agricultural and urban development, introduction of exotic predators, degradation of water quality, and changes in flow regimes.
Rana boylii Foothill yellow-legged frog	SSC	--	--	2,4,5	Fast-moving streams and rivers in chaparral, forests, and woodlands.	Habitat destruction due to agricultural and urban development, introduction of exotic predators, degradation of water quality, and changes in flow regimes.
REPTILES						
Clemmys marmorata marmorata Northwestern pond turtle	SSC	--	--	2,3,4	Lakes, ponds, reservoirs, and slow-moving streams and rivers, primarily in foothills and lowlands.	Habitat destruction, degradation of water quality, and changes in flow regimes.

Source: Harland Bartholomew and Associates, Inc., 1996

Notes:
1. State status data taken from California Department of Fish and Game documents, Endangered and Threatened Animals of California and Listing Dates (Revised January 1995) and Special Animals (Revised August 1994)

SE = State-listed Endangered
ST = State-listed Threatened
SSC = Species of Special Concern

Federal status and probable distribution in Marin and Sonoma counties determined by correspondence with Laurie Simons-United States Fish and Wildlife Service, 9 February 1994.

FE = Endangered
FT = Threatened
FPE = Proposed Endangered
FPT = Proposed Threatened
FC = Candidate for listing under the Endangered Species Act
CNPS 2 = California Native Plant Society List 2
CNPS3 = California Native Plant Society List 3
CNPS4 = California Native Plant Society List 4

2. CNDDB = Natural Diversity Data Base, California Department of Fish and Game, 15 March 1995.
3. Distribution of State listed species and Species of Special Concern confirmed with California Statewide Wildlife Habitat Relationships System, California Department of Fish and Game, April 1990.
4. United States Fish and Wildlife Service letter from Cay Goude, 16 February 1995.
5. Species requested to be included by Caitlin Bean, California Department of Fish and Game Biologist, Region 3.
6. United States Fish and Wildlife Service letter from Joel Medlin, 22 June 1995.
7. Federal Register, 61 (101) 25813-25833.

Habitat Sources:
California Department of Fish and Game Natural Heritage Program, Natural Diversity Data Base, 23 December 1993.
EIP Associates. December 1990. Santa Rosa Sub-Regional Water Reclamation System "Long-Term Wastewater System Draft Environmental Impact Report/Statement."

Note: In a series of federal register notices (50 CFR Part 17, Volume 61, Number 40, 7457-74563 and 7595-7613, February 28, 1996), the United States Fish and Wildlife Service reclassified 96 candidate taxa of plants and animals. The United States Fish and Wildlife Service no longer recognizes a federal candidate category 2 status. There are now 182 plant and 89 animal taxa on a single candidate species list. These taxa are considered by the United States Fish and Wildlife Service as candidates for possible addition to the List of Endangered and Threatened Plants and Animals. As a consequence, the status of many taxa originally included in the analysis has changed, requiring that many taxa be removed from the list of species being considered in this EIR/EIS analysis. See Biological Resources, Volume 2 for further information (Harland Bartholomew & Associates 1996b).

8 Note: There are two closely related subspecies of red-legged frog in the Project area: California and northern. The identity of the species within any one alternative is unclear. Northern red-legged frogs are a California Department of Fish and Game species of special concern. The California red-legged frog is federally-threatened. The recent federal ruling establishing the final status of California red-legged frog as federally-threatened provided the geographic range of the species. Red-legged frogs in the Walker Creek, Sonoma Creek, Petaluma River, and Tolay Creek watersheds are identified as the California subspecies and are considered federally-threatened (personal communication, Karen Miller, USFWS, July 11, 1996.) All other red-legged frogs in the Project area appear to be the northern subspecies, although final confirmation as not been received.

In the current analysis, all red-legged frogs in the Project area are considered to be the California subspecies though the status will be confirmed prior to the Final EIR/EIS. All red-legged frogs not determined to be the California subspecies will be evaluated as a species of special concern. Findings of significance and proposed mitigation are not expected to change.

Table 4.9-2

Relationship of Aquatic Plant Community and Wildlife Habitat Relationship System Habitat Type

Aquatic Plant Community	Corresponding CWHR Habitat
N/A	Estuarine
Coastal Brackish Marsh	Saline Emergent Wetland
Coastal Salt Marsh	Saline Emergent Wetland
Freshwater Marsh	Fresh Emergent Wetland
Freshwater Pond	Lacustrine (Palustrine[1])
Freshwater Seep	Habitat element within various Wildlife Habitat Types
N/A	Riverine
Drainage	Habitat element of Annual Grassland
Seasonally Wet Vegetation	Habitat element of Annual Grassland
Vernal Pool	Habitat Element of Annual Grassland

Source: Grentell, W. E., Jr., 1988. A Guide to Wildlife Habitats of California

Notes:
N/A Not Applicable
CWHR California Wildlife Habitat Relationship System
1. Freshwater ponds are conventionally considered palustrine habitat and will be referenced throughout this section as palustrine, though the CWHR System groups lacustrine and palustrine together under lacustrine.

Titles used below refer to aquatic plant community. Corresponding CWHR habitat is in parentheses.

Estuaries

Estuarine

Estuaries develop in the mouths of partially closed rivers or bays where inflowing fresh water mixes with marine water. Estuaries are dynamic systems influenced by many randomly occurring elements of the physical environment. The water chemistry (e.g., salinity) and hydrology of estuaries are influenced daily and seasonally by tributary stream hydrology and tidal rhythms.

The marine influence of small estuaries of the Sonoma and Marin counties coastal region is interrupted, on a seasonal basis, by sand bar formation at the mouth of the estuaries. During these times, water movement between the marine and

estuarine environments is greatly reduced. The resultant ecosystem is largely defined by the hydrology of the inflowing streams. If the incoming stream flows are perennial and of sufficient volume to overcome evaporative losses, the resultant system will be hyposaline (lower concentration of salt) and a brackish (salt concentration greater than freshwater and less than saltwater) marsh may be formed. If the inflowing streams are intermittent, the resultant ecosystem from evaporative losses may become hypersaline (higher concentration of salt) and support a unique assemblage of salt-tolerant species.

Estuaries provide important habitat for a variety of organisms. Many aquatic organisms complete their entire life cycle within the estuary (e.g., tidewater goby [*Eucyclogobius newberryi*] and staghorn sculpin [*Leptocottus armatus*]). Estuaries are important migration corridors for anadromous salmonids, lampreys, and other fishes. These migratory species must undergo dramatic physiological changes in order to survive the transition between fresh water and saltwater environments. Estuaries provide a location where this transition can occur.

Estuaries in the Area of Indirect Impacts provide habitat elements for cover, resting, reproduction, and foraging for many birds and mammals, including a variety of waterfowl species and special-status birds including California clapper rail (*Rallus longirostris obsoletus*) and California black rail (*Laterallus jamaicensis coturniculus).* Plant cover associated with estuaries provides shelter for shorebirds during severe winter storms. Eelgrass beds are a characteristic element of estuaries. Eelgrass provides a critical food source for migratory brant (*Branta bernicla*) and other water birds. Eelgrass beds are discussed in more detail in the West County regional description.

Coastal Brackish Marsh (Saline Emergent Wetland)

Coastal brackish marsh is a plant community that contains elements from both salt marsh and freshwater marsh plant communities. The plants in this community have evolved in response to a unique set of ecological conditions including seasonal variations in inundation areas, variable salinity, changing hydrology due to seasonal flooding, and periodic desiccation. Salinity may vary considerably, and may increase at high tide or during seasons of low freshwater runoff. Coastal brackish marsh gradually intergrades with coastal salt marsh toward the ocean and along the interior edges of coastal bays, estuaries, and coastal lagoons. Occasionally, coastal brackish marsh intergrades with freshwater marsh at the mouths of rivers (Madrone Associates 1977). Within the Area of Indirect Impacts, coastal brackish marsh is found on the upper reaches of the Estero Americano and the Estero de San Antonio.

Coastal brackish marsh has been classified by the California Department of Fish and Game as a sensitive natural community (California Department of Fish and Game 1995). Plant species found within the coastal brackish marsh community

are normally dominated by perennial, emergent, herbaceous monocots that grow to around six feet in height (Holland 1986). Resident bird species that forage in coastal brackish marshes include the black-crowned night-heron (*Nycticorax nycticorax*), great blue heron (*Ardea herodias*), great egret (*Ardea alba*), and snowy egret (*Egretta thula*) (Harvey et al. 1992). Typical nesting birds in coastal brackish marshes include American bittern (*Botaurus lentiginosus*), cinnamon teal (*Anas cyanoptera*), common yellowthroat (*Geothlypis trichas*), mallard (*Anas platyrhynchos*), marsh wren (*Cistothorus palustris*), sora (*Porzana carolina*), and Virginia rail (*Rallus limicola*) (Harvey et al. 1992). Coastal brackish marshes provide vegetation that is consumed by beavers (*Castor canadensis*) and muskrats (*Ondatra zibethica*). Predators that utilize coastal brackish marshes as foraging habitat include mink (*Mustela vison*), river otter (*Lutra canadensis*), red fox (*Vulpes vulpes*), and northern harrier (*Circus cyaneus*) (Harvey et al. 1992). Special-status animal species that are found in coastal brackish marshes include salt marsh harvest mouse (*Reithrodontomys raviventris*) and California black rail.

Coastal Salt Marsh (Saline Emergent Wetland)

Coastal salt marsh communities are tidally influenced emergent wetland habitats dominated by salt tolerant plants (Lewis 1982). Salt marshes are usually found in sheltered inland margins of bays, lagoons, and estuaries (Holland 1986) and are characterized by the presence of perennial emergent grasses, succulent herbs, and suffrutescent (herbaceous above, with a woody base) shrubs (Springer 1988).

Salinity levels in salt marshes vary temporally and spatially, increasing in dry summer months or at high tide and decreasing during periods of freshwater inflow. Species composition and densities are influenced by the salinity of the supporting water matrix. The very salt-tolerant cord grass (*Spartina* sp.) may dominate communities near open waters while pickleweed often dominates in the mid-littoral (near shore) zones.

Northern coastal salt marsh has been identified by the California Department of Fish and Game as a sensitive natural community.

Salt marsh communities occur at several locations within the Area of Indirect Impacts. The most extensive of these salt marsh communities are associated with the mouths of the Estero Americano and Estero de San Antonio. Salt marsh habitat also occurs along the lower reaches of Walker Creek where it flows into Tomales Bay, along the lower Petaluma River where it enters San Pablo Bay in Marin County, and along the shoreline of Bodega Harbor.

Salt marshes are used by a wide diversity of wildlife species. Waterfowl and shorebird species utilize this habitat for foraging and nesting. Common salt marsh bird species include great blue heron, great egret, American avocet (*Recurvirostra americana*), black-necked stilt (*Himantopus mexicanus*), mallard, ruddy duck

(*Oxyura jamaicensis*), and cinnamon teal. Songbirds such as song sparrow (*Melospiza melodia*), common yellowthroat, red-winged blackbird (*Agelaius phoeniceus*), and marsh wren also nest in this habitat. In addition, raptors such as northern harrier, red-shouldered hawk (*Buteo lineatus*), white-tailed kite (*Elanus leucurus*), and short-eared owl (*Asio flammeus*) forage in salt marshes. Salt marshes also serve as an important winter foraging area for the endangered peregrine falcon (*Falco peregrinus*). Mammal species that are common in this habitat include raccoon (*Procyon lotor*), mink, river otter, a variety of shrews (*Sorex* spp.), voles (*Phenacomys* spp.), and mice. While local reptiles and amphibians do not normally inhabit salt marshes, Pacific gopher snake (*Pituophis melanoleucus catenifer*), garter snakes (*Thamnophis* spp.), Pacific chorus frog (*Pseudacris regilla*), and western toad (*Bufo boreas*) may sometimes be found on the periphery of this habitat.

A variety of special-status plants occur in coastal salt marsh. These species include Point Reyes bird's-beak (*Cordylanthus maritimus* ssp. *palustris*), small spikerush (*Eleocharis parvula*), and marsh gumplant (*Grindelia stricta* var. *angustifolia*). Special-status animal species potentially found in salt marshes include salt marsh harvest mouse, California clapper rail, California black rail, San Pablo vole, San Pablo song sparrow, and saltmarsh yellowthroat.

Static Freshwater Communities

Palustrine (Lacustrine)

Palustrine habitat includes all nontidal wetlands dominated by emergent mosses, lichens, persistent emergents, shrubs, or trees, and tidal wetlands with similar characteristics and salinity levels less than 0.5 percent (Cowardin et al. 1979). Wetlands exhibiting the four following characteristics may also be identified as palustrine (despite the absence of the vegetation described above) (Cowardin et al. 1979):

- Absence of bedrock or active wave-formed shoreline features;
- Water depth less than 6.6 feet at the deepest point of the basin;
- Less than 20 acres in area; and
- Less than 0.5 percent salinity.

Bogs, fens, marshes, prairies, and swamps are vegetated wetlands that are characterized as palustrine habitats. Small ponds (i.e., shallow, intermittent, or permanent water bodies) are also included as palustrine habitat. Palustrine wetlands may be located above the shoreline of estuaries, lakes, river channels, or on river floodplains, on slopes or in isolated catchments. Lakes or rivers may also contain islands of palustrine wetland habitat.

The separation of palustrine and lacustrine habitats is frequently unclear and is primarily determined by the type of water mixing and vegetation present in the water body (Goldman and Horne 1983). When convective mixing (mixing due to thermal gradients) predominates, a water body may be considered a pond. Conversely, a water body may be considered a lake when wind plays the dominant role in mixing. The frequent thermal stratification of pond waters, and abundant growths of floating and rooted aquatic macrophytes are characteristics which also help to define palustrine habitats (Goldman and Horne 1983).

Freshwater Marsh (Fresh Emergent Wetland)

Freshwater marsh vegetation is characterized by herbaceous plants adapted to perennially wet aquatic habitats (hydrophytes) and occurs near the edges of rivers and lakes or in basins or depressions that flood periodically. In the Area of Indirect Impacts, freshwater marsh habitat may be found in association with perennial streams, around farm ponds, or adjacent to the margins of estuaries.

Coastal and valley freshwater marsh is a type of plant community that has been identified by the California Department of Fish and Game as a sensitive natural community.

The roots of marsh plants are adapted for anaerobic conditions during periods of inundation. Perennial monocots such as Baltic rush and nutsedge (*Cyperus esculentus*) often dominate the upper fringes of marsh habitats, whereas cattails and tules (*Scirpus acutus* var. *occidentalis*) occur in deeper waters.

Freshwater marsh supports a high diversity of wildlife species. Many species of fish, amphibians, reptiles, birds, and mammals depend upon marshes for food, cover, and water. The entire life cycle of many species is completed within this wetland habitat. Birds are particularly suited to exploit this habitat. Typical species found in freshwater marsh include belted kingfisher (*Ceryle alcyon*), great blue heron, green heron (*Butorides virescens*), great egret, American coot, marsh wren, and red-winged blackbird. Freshwater marshes also provide important feeding and resting habitat for resident waterfowl including mallards and migratory waterfowl such as ring-necked ducks (*Aythya collaris*). Other common vertebrate species found in the freshwater marsh community include bullfrog (*Rana catesbeiana*), Pacific chorus frog, western aquatic garter snake (*Thamnophis couchi*), common garter snake (*Thamnophis sirtalis*), muskrat, raccoon, shrews and cottontails (*Sylvilagus* spp.) Carp (*Cyprinus carpio*), mosquito fish (*Gambusia affinis*), bullhead, and sunfish (*Lepomis* spp.) are common fish species found in marshes. Many of these fish species provide an important food source for predators which hunt in the marsh environment.

Many special-status plant species, including Sonoma alopecurus (*Alopecurus aequalis* var. *sonomensis*), Bolander's reed grass (*Calamagrostis bolanderi*),

Thurber's reed grass (*Calamagrostis crassiglumis*), swamp harebell (*Campanula californica*), white sedge (*Carex albida*), and Pitkin Marsh lily (*Lilium pardalinum* ssp. *pitkinense*) are found in freshwater marsh habitats. Special-status animal species associated with freshwater marsh habitats include tricolored blackbird (*Agelaius tricolor*), great blue heron, short-eared owl, and northern harrier (Table 4.8-1).

Portions of the bay lands, including areas potentially containing freshwater marshes, were not accessible for on-site surveys. Therefore, color aerial photographs (3x3 inch color slides; April 1994) were used to map and evaluate the vegetative communities. Although wetland areas were discernible on the photographs, it was not possible to determine the type of wetland habitat present, for example, freshwater marsh, seasonal wetland, vernal pool, or brackish marsh. Therefore, these areas were mapped as "undetermined wetland type."

Freshwater Pond (Lacustrine)

Palustrine habitats within the Area of Indirect Impacts include man-made impoundments created by the damming of natural drainage channels. These impoundments (freshwater ponds) primarily collect water for agricultural uses including irrigation and livestock watering. Phytoplankton such as algae and diatoms comprise the greatest biomass of plant species in freshwater ponds (Grenfell 1988). Shoreline vegetation often consists of floating rooted aquatic plants such as water lily (*Nuphar* spp.) and knotweed (*Polygonum* spp.). California bulrush (*Scirpus californicus*) and common cattail (*Typha* spp.) are typical freshwater marsh plants that frequently occur along the shorelines of freshwater ponds (Grenfell 1988). Vegetation is commonly harvested from stock ponds in the fall to provide greater storage capacity for the following spring.

Freshwater ponds provide important nesting habitat for resident birds including mallard, pied-billed grebe (*Podilymbus podiceps*), American coot (*Fulica americana*), song sparrow, and red-winged blackbird. In winter, migratory waterfowl utilize this habitat type for feeding and resting (e.g., lesser scaup [*Aythya affinis*]). Garter snakes and bullfrogs also frequently occur in this aquatic habitat type. Many species of sunfish and catfish (*Ictalurus* spp.) are often stocked in man-made freshwater ponds.

There are no special-status plant species specifically associated with man-made freshwater ponds. Special-status animal species found in freshwater ponds include northwestern pond turtle (*Clemmys marmorata marmorata*).

Although considered as palustrine under the Cowardin classification system, man-made freshwater ponds are included under the CWHR lacustrine habitat type (see Table 4.9-2).

Freshwater Seep (Element of Many Wildlife Habitat Types)

Seeps occur where the groundwater table is high or where underground springs seep water out of the ground. Seeps are common at many locations throughout the Area of Indirect Impacts, and may form permanently or temporarily wet conditions. Seepage from underground springs produces an environment conducive to the growth of hydrophytic grasses, rushes, sedges, and herbaceous vegetation.

Freshwater seeps are included as a habitat element within various Wildlife Habitat Relationship System habitat types (Table 4.9-2). Many species of mammals and small birds utilize freshwater seeps as a source of water and cover. Reptiles and amphibians that occasionally use freshwater seeps include garter snakes and Pacific chorus frog.

Freshwater seep communities have the potential to support several special-status plant species including Mount Tamalpais thistle (*Cirsium hydrophilum* var. *vaseyi*), California lady's-slipper (*Cypripedium californicum*), Geyser's dichanthelium (*Dichanthelium lanuginosum* var. *thermale*), and California beaked-rush.

Seasonally Wet Vegetation (Element of Annual Grassland)

Seasonal wet vegetation wetland is a common plant community or habitat in the Area of Indirect Impacts. This plant community or habitat occurs in shallow depressions, swales, and drainages that fill with precipitation and runoff, and remain saturated or inundated during winter and spring months. These habitats support species adapted to temporarily wet conditions followed by long periods of desiccation. Seasonal wetlands support many of the same types of species found in vernal pools and freshwater seeps.

Seasonal wetlands provide important foraging habitat for migratory waterfowl and shorebirds, and nesting habitat for mallard and cinnamon teal. Wildlife species observed utilizing seasonal wetlands also include black-tailed deer (*Odocoileus hemionus*), black-tailed jackrabbit (*Lepus californicus*), California ground squirrel (*Spermophilus beecheyi*), gopher snake, gray fox (*Urocyon cinereoargenteus*), and muskrat (Harvey et al. 1992). This wetland habitat type also often supports a high diversity of small aquatic invertebrates, (i.e., zooplankton, mollusks, crustaceans, and aquatic insect larvae). In addition, vertebrates such as Pacific tree frog use seasonal wetlands as breeding habitat.

Special-status plant species that occur in habitats which support seasonally wet vegetation include Sonoma sunshine, Sebastopol meadowfoam (*Limnanthes douglasii* ssp. *sulphurea*), Baker's navarretia (*Navarretia leucocephala* ssp. *bakeri*), Burke's goldfields (*Lasthenia burkei*), and Douglas's pogogyne

(*Pogogyne douglasii* ssp. *parviflora*). Special-status animal species that use seasonal wetlands as breeding habitat include California tiger salamander (*Ambystoma californiense*).

Vernal Pool (Element of Annual Grassland)

Vernal pools, a subclass of seasonal wetlands, occur in formed depressions in grasslands and other habitats that are underlain with an impervious layer. These depressions fill with water in the winter and slowly dry in the spring and summer. Vernal pools are characterized by four different stages. These stages include a filling stage in the fall, a holding stage in the winter, a drying stage in the spring, and a dry stage through the summer (Zedler 1987). Vernal pools are classified according to the substrate on which they occur. These substrates include terrace soils, volcanic mudflows, and hardpan.

Northern vernal pool and northern hardpan vernal pool are two types of vernal pools that occur in the Area of Indirect Impacts and have been identified by the California Department of Fish and Game as sensitive natural communities.

Spectacular spring wildflower displays develop in vernal pools. As water in the vernal pools recedes during the spring, vernal pool annual plants begin to germinate and grow. A concentric display (i.e., rings) of small but brightly-colored annual plants develops in the vernal pool basin as different plant species respond to the different and changing temperatures and hydrology of the drying pool. These concentric rings are not exhibited by all vernal pools, but are unique to vernal pools in California. This ecosystem is therefore relatively easy to identify during the spring and summer months, when surrounding vegetation is often dry and brown.

Vernal pools are included as a habitat element of the CWHR annual grassland habitat type (Table 4.9-2). Vernal pools are characterized by a high diversity of aquatic insect larvae and other macroinvertebrates including several species of endangered or threatened species of vernal pool shrimp. Pacific chorus frog and the special-status California tiger salamander use vernal pools as breeding habitat. In addition, many other wildlife species including cinnamon teal, common snipe (*Gallinago gallinago*), great egret, greater yellowlegs (*Tringa melanoleuca*), lesser yellowlegs (*Tringa flavipes*), mallard, and snowy egret, have been observed utilizing vernal pools as foraging or nesting habitat (Harvey et al. 1992). Migratory shorebirds and waterfowl make extensive use of vernal pools as foraging habitat during the winter months. Mammals that generally occur in the surrounding grassland habitat and occasionally use vernal pools include black-tailed jackrabbit, California vole (*Microtus californicus*), deer mouse (*Peromyscus maniculatus*), and western harvest mouse (*Reithrodontomys megalotis*) (Harvey et al. 1992).

Vernal pools support a unique ecosystem. Introduced species make up less than seven percent of the total number of species found in vernal pools (Holland and Jain 1977). Of the 32 special-status plant species addressed in this section of the EIR/EIS, 10 species are associated with vernal pools or other seasonal wetlands. Representative special-status plant species that may be found in vernal pools of the Area of Indirect Impacts include dwarf downingia (*Downingia pusilla*), Sonoma sunshine (*Blennosperma bakeri*), Sebastopol meadowfoam, many-flowered navarretia (*Navarretia leucocephala* ssp. *plieantha*), and Burke's goldfields.

Rivers and Streams (Riverine)

Riverine habitats are channeled wetlands, such as rivers and streams, that are created naturally or artificially. Riverine habitats can be characterized as perennial (permanent flow) or intermittent (periodic flow) depending on flow regime. Streams and rivers originate from higher elevation sources (springs and lakes) and flow downward at a rate relative to slope and water volume. Water velocity will normally decline as the stream approaches progressively lower elevations, while water volume will continue to increase until the flow becomes slow-moving. During this transition from fast-moving to slow-moving water, temperature and turbidity tends to increase, while dissolved oxygen decreases or becomes more variable (Grenfell 1988).

Open waters of rivers and streams provide suitable foraging habitat for gulls (*Larus* sp.), osprey (*Pandion haliaetus*), and bald eagle (*Haliaeetus leucocephalus*). Waters near shore provide foraging habitat for waterfowl, herons, shorebirds, and belted kingfisher (*Ceryle alcyon*). Insect-eating birds include swallows, flycatchers, and swifts that forage above the open waters. Common mammals found in riverine habitats include striped skunk (*Mephitis mephitis*), raccoon, mink, river otter, and muskrat (Grenfell 1988).

Aquatic riverine habitats are often classified according to their ability to support different faunal (i.e., animal) assemblages (Merritt Smith Consulting 1996b). Assessment of aquatic riverine habitat quality is based on a combination of factors including water temperature, water quality, extent of riparian canopy, substrate type, stream gradient (i.e., slope), presence of riffles (i.e., areas of shallow turbulent water passing through or over stones on gravel of a fairly uniform size), amount of instream shelter, presence and quality of gravel spawning beds, bank stabilization, abundance of insects, and permanence (i.e., perennial or intermittent).

Ephemeral/Drainage (Riverine)

Ephemeral riverine habitats (including drainages) contain flowing water for only part of the year. Flow may cease anytime from late spring to early autumn

depending on the water source and climate. Standing water may or may not remain as isolated pools within the streambed. Substrate types of intermittent riverine habitats range from fine sediments to mud to bedrock. Vegetation along intermittent streams (if present) includes spike rush, toad rush, spreading rush, prickle-fruited buttercup, and water sedge. The wildlife species that commonly utilize intermittent streams include garter snakes and bullfrog.

Special-status animal species occasionally found inhabiting intermittent streams (with at least some permanent pools) include California freshwater shrimp (*Syncaris pacifica*) and Tomales isopod (*Caecidotea tomalensis*). Special-status plant species that may occur in intermittent streams include Rattan's milk-vetch, streamside daisy, and Lobb's aquatic buttercup.

Perennial (Riverine)

Perennial streams flow year-round. Perennial riverine habitats can be grouped into two separate categories; lower perennial and upper perennial.

Upper perennial riverine habitats have steeper gradients and higher current velocities than lower perennial habitats. The substrate of upper perennial streams generally consists of rock, cobble, or gravel, with occasional patches of sand. Shallow, fast-flowing reaches have gravel or boulder substrates and are called "riffles." Deep, slow-flowing reaches have sand or mud substrates and are called "pools." The characteristic species assemblages of upper perennial riverine habitats are primarily associated with the rocky substrates of riffles and include diatoms, mayflies, stoneflies, and black flies. Fish species associated with upper perennial riverine habitats include steelhead trout, Coho salmon, sculpin (*Cottus* sp.), splittail, hard head *(Mylopoharodon canocephalus)* and California roach *(Hesperoleucus symmetricus)*. Protected pools may support species similar to those found in lower perennial riverine habitats due to the similarities in substrate size and stream flow velocity, but more often harbor only salmonids or sculpin (Jones & Stokes Associates 1981).

Special-status species found in perennial streams include Tomales isopod, California freshwater shrimp, Coho salmon, steelhead, California red-legged frog, foothill yellow-legged frog, northwestern pond turtle, splittail, and hardhead.

Lower perennial riverine habitats are characterized by a gentle gradient and are associated with the lower reaches of streams that approach ocean outfall (Jones & Stokes Associates 1981). These streams reach relatively low current velocities. The stream bottom is typically composed of mud or sand.

Characteristic species assemblages found in lower perennial habitats consist of planktonic organisms such as diatoms, copepods, and green algae, as well as sand or mud bottom-dwellers including amphipods, midge fly larvae, and freshwater clams. Native fish species found in lower perennial habits include Sacramento

sucker (*Catostomus occidentalis*), California roach, Sacramento blackfish (*Orthodon microlepidotus*), and Sacramento squawfish (*Ptychocheilus grandis*). Introduced species found in lower perennial habitats include several species of centrarchids (i.e., black bass, smallmouth bass, bluegill, green sunfish, and black crappie).

Regional Resource Planning Efforts

Many fish and other aquatic species are commercially and recreationally important. In addition, unique and sensitive aquatic resources exist throughout the Area of Indirect Impacts. Consequently, many private and public large-scale planning efforts have been undertaken throughout Sonoma and Marin counties in part to protect, restore, and conserve these resources. A summary of the major regional planning efforts and their guidelines for natural resources protection is presented in Table 4.8-4 in the Terrestrial Biological Section.

Local Geographic Area Resource Description

The Project area in Sonoma and northern Marin counties can be divided into five relatively distinct geographic areas (i.e., Santa Rosa Plain/Russian River, West County, South County, Sebastopol, and geysers) based primarily on watersheds and their associated aquatic and terrestrial biological resources. A brief discussion of local watersheds, associated aquatic resources (including special-status species), and local resource planning efforts of each geographic region is provided below (see Figures 4.8-1a, 1b, and 1c in Section 4.8, Terrestrial Biological Resources).

Santa Rosa Plain/Russian River

The major watersheds associated with the Santa Rosa Plain/Russian River geographic area are the Russian River and the Laguna de Santa Rosa. Mark West Creek is a major tributary draining into the Russian River from the northwest and the Laguna de Santa Rosa from the south. Santa Rosa Creek is the main tributary draining the Laguna de Santa Rosa from the east. However, other smaller perennial and intermittent creeks are also present within this geographic area.

Russian River

The Russian River, which drains approximately 1,485 square miles in Mendocino and Sonoma counties, originates in Mendocino County, meanders south through the Alexander Valley, and eventually cuts through the Mendocino Range to the ocean at Jenner. The Russian River is the largest river between San Francisco and Point Delgado on the northern California coast, measuring 110 miles in length (Goodwin et al. 1994). Large creek systems that flow from the surrounding steep, mountainous terrain comprise the watershed of the river. These creeks drain to

the flat, alluvial valleys of the upper and middle river, and to the lower canyon that begins at Wohler Bridge. The river reaches tidewater near Duncan Mills and enters the ocean at Jenner where an estuary has formed.

The Russian River has been impacted by agricultural and urban development, and flow is controlled by impoundments at Lake Mendocino and Lake Sonoma (EIP 1990). Flow releases from these reservoirs during the summer and winter months strongly influence river hydrology and temperature, which in turn influences the composition of the aquatic community in the river. Other impacts to the river include treated wastewater discharges from the cities of Healdsburg, Santa Rosa, and others (the winter discharge from the Santa Rosa Subregional System flows from the Laguna de Santa Rosa into the river at Mirabel); gravel mining; summer check dams; water diversions; septic system discharges; flooding; and urban and agricultural runoff. Vineyards, gravel skimming operations, and cattle grazing also occur at numerous points along the river.

The Russian River provides wildlife and fish habitat, many recreational use areas, and a drinking water supply. Several species of warmwater fish are resident in the river, while cold-water fish (i.e., steelhead trout and coho salmon) occur primarily as migrants between the ocean and the upriver spawning habitat. The Sonoma County Water Agency and the Windsor Water District, as well as numerous communities, divert drinking water from the river. Residents and vacationers swim, canoe, and fish along the river in many areas. Many vacation homes lie downstream of Wohler Bridge.

The Russian River is essentially a "warmwater" fish habitat for at least five months of each year, which means that water temperatures are too high in summer for salmonids (steelhead, coho salmon, chinook salmon) and other "coldwater" fishes (Merritt Smith Consulting 1995). Salmonids are not year-round residents of the river. Salmonid spawning and juvenile rearing take place in the upper reaches of smaller tributaries where suitable spawning gravels are present and cooler water persists throughout the summer months. The fish species resident in the mainstream throughout the year are native species such as Sacramento sucker, hardhead, Sacramento squawfish, and California roach, and introduced warmwater species such as carp, smallmouth bass, largemouth bass, bluegill, and catfish.

The Russian River estuary, which consists of the lower few miles of the river between Duncan Mills and Jenner, is subject to sand bar closure at the mouth during summer low flow periods. However, in recent years, the mouth has been kept open by artificial means to prevent flooding of homes located along the banks near Jenner. Artificial breaching of the sand bar in the summer of 1992 and spring of 1993 appeared to have minimal impacts on the estuarine community. However, historical biological data associated with the estuary are lacking (Goodwin 1994). The estuary supports fish species typical of other

estuaries in the region including Pacific herring (*Clupea harengus*), topsmelt (*Atherinops affinis*), bay pipefish (*Syngnathus leptorhynchus*), shiner surfperch (*Cymatogaster aggregata*), starry flounder (*Platichthys stellatus*), staghorn sculpin (*Leptacottus armatus*), and threespine stickleback (*Gasterosteus aculeatus*) (California Department of Fish and Game 1984, M. Fawcett, pers. communication). Other fish species occasionally captured by fishermen in the Russian River estuary include striped bass and white sturgeon (*Acipenser transmontanus*). However, neither of the latter two species are residents or routine visitors to the Russian River estuary. The occasional captures probably represent straying or feeding forays by individuals during their movements along the coast.

Two species of pinnipeds (seals and sea lions) consistently use the area at the mouth of the Russian River. Harbor seals (*Phoca vitulina*), sometimes numbering in the hundreds, are found at this site all year and use the sandspits on either side of the river mouth as haul-out locations (areas where pinnipeds congregate to rest). Their preferred haul-outs on the sandspits are located inside the estuary near the river mouth rather than on the outside adjacent to the open ocean. California sea lions (*Zalophus californianus*) are also present in the area from December through June each year. In contrast to the large resident harbor seal population, sea lion numbers are low (rarely more than five individuals), as they normally do not come ashore at this site. Sea lions forage, as do a small number of harbor seals, in the area near the river mouth. Juvenile elephant seals were occasionally seen on the haul-out during 1992. Their appearance is unusual since they have not been previously reported using this site as a haul-out location (Sonoma County 1994). Other mammals that live in or are associated with the river include mink, river otter, and raccoon.

Laguna de Santa Rosa

The Laguna de Santa Rosa (Laguna) is a major tributary of the lower Russian River. The Laguna is a wide, marshy area lying along the western edge of the Santa Rosa Plain that drains to the Russian River. The boundaries of the Laguna de Santa Rosa have lacked a clear definition in the past. The headwaters of the Laguna are located in the hills south and east of the City of Santa Rosa. The creek then enters the Santa Rosa Plain near Stony Point Road and meanders to the north. Immediately west and north of the City of Santa Rosa, the Laguna de Santa Rosa merges with Mark West Creek. Some have referred to the waterway as Mark West Creek from this point to the Russian River, and others have referred to the waterway as the Laguna de Santa Rosa. For the purposes of this report, the Laguna de Santa Rosa is defined as the waterway and its associated flood plain in the Santa Rosa Plain located below an elevation of 75 feet above mean sea level, between Stony Point Road to the south and the Russian River to the north.

The Laguna watershed covers approximately 250 square miles (160,000 acres) and is bounded by the Sonoma Mountains on the east and low foothills on the north, south, and west. Most of the streams feeding into the Laguna originate on the east side of the valley and include Santa Rosa Creek, Roseland Creek, and Matanzas Creek. Blucher Creek originates on the west side of the valley.

The Laguna area formerly supported a gently sloping complex of riparian forests, marshes, and lakes. However, due to commercial and residential development over the last several decades, very little of this complex remains. On higher ground, remnants of oak savanna and grasslands of the Santa Rosa Plain are present among the farmlands. Although many of the area's wetlands have been degraded or eliminated by development, the Santa Rosa Plain still supports many types of wetlands including vernal swales, vernal pools, other seasonal wetlands, permanent ponds, marshes, intermittent and perennial creeks, and the Laguna de Santa Rosa (CH2M Hill 1995).

The Laguna is a slow-moving stream of very slight gradient which overflows its banks regularly. The Laguna floodplain serves as an important flood storage area for the Russian River (De Mars et al. 1977), storing up to nearly 80,000 acre-feet of water during 100-year flood events. This retention capacity translates into a 14-foot reduction of the flood peak at Guerneville on the Russian River.

In addition to the flood control benefit of the Laguna, the area provides extensive lands that are suitable for farming and ranching. Agricultural uses of the Laguna area include dairy operations, vineyards, orchards, and small ranches. These diverse land uses provide a valuable open space greenbelt.

Marshes and seasonal wetlands in the area surrounding the Laguna provide wildlife (including waterfowl) and fish habitat, and opportunities for recreational and local educational uses such as hunting and birdwatching (CH2M Hill 1995). Several rare or endangered animal and plant species are found in the habitat provided by these wetlands. Nearly 300 animal species, including California roach, carp, Sacramento sucker, Pacific chorus frog, and northwestern pond turtle, are known to occur in the Laguna area (Smith and CH2M Hill 1990). The Laguna also serves as a migration corridor for fish. Steelhead trout and coho salmon migrate through the Laguna to their natal (original location where fish were hatched) streams to spawn.

The Laguna receives reclaimed water from the Santa Rosa Subregional System and Windsor Water District and is also influenced by urban and agricultural runoff. Stormwater runoff from four cities (Santa Rosa, Sebastopol, Cotati, and Rohnert Park) contributes metals, solids, and nutrients to the Laguna. Dairies, vineyards, orchards, and grazing lands also drain to the waterway and add to the nutrient and solid loads of the Laguna.

Mark West Creek

Mark West Creek is one of the principal tributaries of the Laguna de Santa Rosa and the Russian River. Mark West Creek enters the Russian River at Mirabel Park and drains an area of approximately 254 square miles in the southeastern portion of the drainage basin (EIP 1990). Mark West Creek is a perennial stream that supports an annual run of steelhead trout and provides habitat for other resident special-status species including northwestern pond turtle and Russian River tule perch. Although Mark West Creek also provides suitable habitat for other special-status aquatic species such as foothill yellow-legged frog, California red-legged frog, and coho salmon, these species were rare or absent during recent surveys of the creek (Merritt Smith Consulting 1996b, 1996c, 1996d).

Santa Rosa Creek

The Santa Rosa Creek watershed is located in central eastern Sonoma County and includes most of the City of Santa Rosa. Santa Rosa Creek drains an area of approximately 78.6 square miles, which includes a variety of agricultural, parks and open space, and urban land uses. The creek is approximately 22 miles long from the headwaters in Hood Mountain Regional Park to the confluence with the Laguna de Santa Rosa. Elevation along the creek ranges from about 1,500 feet above mean sea level (msl) at the uppermost headwaters to about 40 feet above msl at the confluence with the Laguna de Santa Rosa. Santa Rosa Creek once provided a local drinking water supply (through the late 1800s), but is currently impacted by dairy runoff and stormwater flows from the City of Santa Rosa (Ralph J. Alexander & Associates 1993).

Channelization of Santa Rosa Creek (after the 1955 flood) decreased the in-stream shelter, reduced riparian canopy and substrate, and eliminated cool temperatures required by native aquatic species in the lower reaches. Consequently, the lower reach of Santa Rosa Creek (Santa Rosa Flood Control Channel) is now a warmwater habitat which supports aquatic fauna very similar to the Russian River. The upper reaches of Santa Rosa Creek remain in a semi-natural condition (with cool water and a dense canopy) and support an annual spawning run of wild steelhead trout (Merritt Smith Consulting 1995).

West County

The major watersheds associated with the West County area are Americano Creek, Stemple Creek, Estero Americano, and Estero de San Antonio. However, other perennial and ephemeral creeks are also present within this geographic area. The Laguna de Santa Rosa and its major tributaries are described under the Santa Rosa Plain/Russian River geographic area.

Americano Creek and the Estero Americano

Americano Creek is about 10 miles long and drains approximately 49 square miles in Sonoma and Marin counties. The main channel of Americano Creek has been heavily influenced by potato farming, livestock grazing, and dairy farming (Madrone Associates 1977, California Coastal Commission 1987, Buell and Associates 1988). Historically, the Americano Valley was cleared primarily for potato cultivation in the last quarter of the 1800s (John Cummings, personal communication, November, 1995). In addition, due to trampling by livestock, the Americano Creek streambed is buried in silt and the banks have slumped and eroded (Smith 1988). Heavy grazing pressures have left the riparian vegetation highly fragmented. Though Americano Creek becomes dry each summer, isolated freshwater pools remain within the streambed. Cattle often utilize these pools as a water source, strip the vegetation, and pollute the water with cattle waste. The few remaining unpolluted pools with intact upland vegetation, which are located in upper tributaries, provide suitable habitat for California red-legged frog and northwestern pond turtle. Spawning runs of steelhead trout and coho salmon have been eliminated, though three individual steelhead trout have been observed in a tributary of the Americano Creek (Harland Bartholomew & Associates 1996a). California freshwater shrimp also once occurred in the Americano Creek, but have apparently been extirpated (Serpa 1991).

Americano Creek discharges to Bodega Bay through the Estero Americano. This estuary is an eight-mile long tidal embayment that extends inland (Commins et al. 1990). The Estero Americano is narrow and relatively shallow (depth at mean high water varies from two to seven feet). Widths range from a few feet near the upper (landward) end to about 1,000 feet in some locations in the middle reaches of the estuary. The Estero encompasses approximately 300 acres, with adjacent wetland habitats extending over an additional 412 acres. The Estero is connected to Bodega Bay by a narrow inlet channel across the beach. Daily tidal and freshwater action along with southwesterly littoral currents results in sand bar formation at the bay mouth that somewhat restricts tidal exchange with the ocean (United States Fish and Wildlife Service 1981). The Estero Americano sand bar is breached on an almost annual basis in the spring. During the late summer and early fall of some years, when the bars are not opened naturally or artificially, the Estero functions as a hypersaline lagoon due to high evaporation and elimination of tidal influence (Madrone Associates 1977). A mudflat appears in the middle reach of the lower Estero during the winter months and provides important foraging habitat for shorebirds (Commins et al. 1990).

Marine fish species such as ling cod (*Ophiodon elongatus*) and cabezon (*Scorpaenichthys marmoratus*) may enter the Estero to forage during high tides but are excluded from the Estero during the months when the bars are closed. When the sand bars are open, species diversity increases due to an influx of marine fish species that are adapted to both estuarine and marine environments

(e.g., starry flounder and English sole [*Parophrys vetulus*]) and those fish species that complete their life cycle within estuarine environments (e.g., shiner surfperch [*Cymatogaster aggregata*] and tidewater goby). Species that spawn in the Estero (e.g., Pacific herring [*Clupea harengus*] and topsmelt [*Atherinops affinis*]) or spend the early part of their life cycle in estuaries (plainfin midshipman [*Porichthys notatus*]) are also present in the Estero (Merritt Smith Consulting 1996a). The Estero Americano historically supported spawning runs of coho salmon and steelhead trout. Occasional steelhead adults still wander into this watershed (CSCC 1977, Buell and Associates 1988, Merritt Smith Consulting 1996a).

The composition of the fish species assemblage in the Estero at any given time is strongly influenced by the relative salinity of the water. Species diversity increases as salinity increases when the sand bars are open, particularly near the mouth of the Estero. Decreased species diversity occurs when the bars are closed, primarily because salinity in the lower reaches of the Estero is reduced and coastal recruitment of marine species is precluded.

In addition to the more than 45 fish species documented in the Estero Americano, over 110 benthic invertebrate species have also been identified (Merritt Smith Consulting 1996a). The most common invertebrates are mysids, including caridian shrimp (*Crangon* spp.) and crabs. Crab species inhabiting the Estero Americano include Dungeness crab (*Cancer magister*), rock crab (*Cancer antennarius*), yellow shore crab (*Hemigrapsis oregonensis*), and the introduced green crab. Tidewater goby, a federal/state endangered species, is the only special-status aquatic species known to occur in the Estero Americano (Merritt Smith Consulting 1996a).

Stemple Creek and Estero de San Antonio

The Stemple Creek watershed is located immediately south of the Americano Creek watershed. This watershed begins east of Petaluma and empties into the Pacific Ocean through the Estero de San Antonio. The watershed encompasses approximately 50 square miles, almost all of which is in agricultural production. The drainage is cut almost exactly in half by the Sonoma-Marin county line. Though probably perennial in the past, Stemple Creek is now ephemeral (Prunuske Chatham 1994). The mainstem and tributaries of Stemple Creek have been heavily influenced by livestock ranching and other agricultural operations. On the eastern and western ends of the watershed, near Petaluma and Dillon Beach, rural residential development is encroaching on the watershed. The land draining into Stemple Creek is largely gently-sloping grassland (Prunuske Chatham 1994).

The Estero de San Antonio has become degraded through historic cattle utilization (Merritt Smith Consulting 1996a). Most of the mainstem flows through dairy and

other livestock operations, resulting in fragmented riparian vegetation and eroded streambanks. The streambed consists primarily of silt and the pools that persist during the summer are typically trampled and polluted by cattle. The few remaining unpolluted pools with intact upland vegetation provide suitable habitat for California red-legged frog, northwestern pond turtle, and California freshwater shrimp (Serpa 1991). The stream formerly supported runs of steelhead trout and coho salmon, but these runs were extirpated by the 1970s (Madrone Associates 1977).

A sand bar often forms periodically in the inlet to the Estero de San Antonio. However, spring tidal flows are usually strong enough to erode the accumulated sand and breach the bar. During years when normal spring tidal flows do not occur, the sand bar may persist until sufficient rainfall runoff accumulates to cut through and overtop the bar (Merritt Smith Consulting 1996a).

Stemple Creek becomes an estero near the community of Fallon and flows about seven miles to the west, crossing under State Highway 1 on its way to the Pacific Ocean. Estero de San Antonio, an embayed river mouth, lies within the northern two miles of Marin County (United States Fish and Wildlife Service 1981). The 93 acres of open water of the Estero reach a depth of approximately 20 feet and may vary in width from 20 feet to almost 200 feet. The Estero de San Antonio has not been observed to develop hypersaline conditions, due in part to the restricted tidal exchange and the freshwater inflow from Stemple Creek. Much of the wetland habitat along the Estero de San Antonio is considered to be seasonal brackish marsh (Madrone Associates 1977). The wetlands of the Estero de San Antonio encompass approximately 191 acres of the watershed (Merritt Smith Consulting 1996a).

Research results indicate that the aquatic animal species diversity is lower in the Estero de San Antonio than in the Estero Americano. Thirteen species of fish and 20 species of benthic invertebrates have been identified in the Estero de San Antonio (Commins et al. 1990, Madrone Associates 1977, Merritt Smith Consulting 1996a). Common species identified for the Estero Americano are also common to the Estero de San Antonio. Tidewater goby is the only special-status aquatic species known to occur in the Estero de San Antonio (Merritt Smith Consulting 1996a).

Eelgrass beds are a special habitat feature of both the Estero Americano and Estero de San Antonio. While both esteros are composed primarily of open water habitat with relatively bare muddy or sandy bottom, there are several reaches that contain luxuriant beds of eelgrass. The Estero Americano contains roughly nine acres of eelgrass beds, while the Estero de San Antonio has approximately two acres of eelgrass beds. Eelgrass beds occur primarily in the subtidal zone because the plants are relatively intolerant to air exposure (Jones & Stokes Associates 1981). Eelgrass is a flowering plant that roots in the soft muddy bottom

sediments and provides habitat for marine invertebrates and fish (Prunuske Chatham 1994). This plant species is tolerant of a wide range of salinities, from as high as 42 parts per thousand (ppt) to as low as 10 ppt (Prunuske Chatham 1994).

Shrimp and gastropods graze on algae that grow on eelgrass blades. Other invertebrates that occur in eelgrass beds include isopods, amphipods, decapods, and sea slugs (*Phyllaplysia taylori*). A variety of fish, including surfperches, sculpins, gobies, pipefish, gunnels, kelpfish, and herring, spawn in eelgrass (Prunuske Chatham 1994). These habitats are typically quite productive and provide a refuge from predation for a variety of invertebrates and fish. Loons, grebes, cormorants, ducks, and gulls are birds that forage in and around eelgrass beds because of the rich prey base associated with this plant community. Harbor seals have also been observed foraging in the vicinity of eelgrass beds.

Mudflats, which occur at the mouths of the Estero Americano and Estero de San Antonio, are an important habitat element of the West County region. Approximately 89 acres of mudflats have been mapped for the Estero Americano, and about five acres of mudflats have been mapped for the Estero de San Antonio (Harvey 1990).

The formation of mudflats occurs when stream sediments and ocean-born sediments are deposited in the shallow areas of an estuary. Within the esteros, mudflats are characterized by the presence of soft substrate invertebrates and algal populations (Madrone Associates 1977). Typical invertebrate fauna include bivalve species such as common softshell clam (*Mya arenaria*), sand clam (*Macoma secta*), and bent-nosed clam (*Macoma nasuta*), as well as limpets, sea slugs, polychaete worms (*Glycera capitata* and *Streblospia benedicti*), and various crustaceans including amphipods, yellow shore crab, ghost shrimp (*Callianassa* sp.), opossum shrimp, rock lice, and Dungeness crab (Madrone Associates 1977).

The invertebrates associated with mudflats provide a rich food source for a variety of shorebirds including western sandpiper (*Calidris mauri*), least sandpiper (*Calidris minutilla*), dunlin (*Calidris alpina*), killdeer (*Charadrius vociferus*), willet (*Catoptrophorus semipalmatus*), marbled godwit (*Limosa fedoa*), greater yellowlegs, American avocet (*Recurvirostra americana*), and long-billed and short-billed dowitchers (Connors and Maron 1989). Most of the shorebirds found in the esteros are migratory and are most common during the fall and spring months. Shorebirds tend to move in and out of the esteros on a tidal schedule, maximizing the amount of time that they can forage during low tide (Prunuske Chatham 1994).

South County (Including Bay Lands)

The three major watersheds in the South County geographic area are the southern portion of the Laguna de Santa Rosa, Petaluma River, and Tolay Creek. Crane Creek and Copeland Creek feed into the Laguna de Santa Rosa. The main tributaries draining into the Petaluma River in the South County area are Adobe Creek, Lichau Creek, and Willowbrook Creek. The Petaluma River, Tolay Creek, and Sonoma Creek in turn are major tributaries that drain into San Pablo Bay. The Laguna de Santa Rosa and its major tributaries are described under the Santa Rosa Plain/Russian River geographic area.

Petaluma River

The Petaluma River originates in the interior valleys of the Coast Range and flows south to San Pablo Bay. The watershed encompasses approximately 52 square miles. Stream flow data recorded from 1948 through 1963 by the U.S. Geologic Survey (USGS) indicate that no freshwater inflow occurred during the summer months of most years and that the maximum river flows during this period occurred in November through April from storm-related runoff. From October 21 through April 30, the City of Petaluma Utilities Department discharges treated effluent through a submerged outfall to the Petaluma River. The Petaluma River is characterized by mixed daily tides in which two high tides and two low tides occur each day.

The Petaluma River and associated marsh provide important habitat to anadromous and resident fish species. Anadromous (life history pattern in which a fish spawns in freshwater, then young fish migrate to sea to mature) fish species include chinook salmon, steelhead trout, striped bass, American shad (*Alosa sapidissima*), and white sturgeon. Resident fish of the Petaluma River and marsh include largemouth bass, black crappie, brown bullhead (*Ictalarus nebulosus*), and green sunfish. Salt-tolerant species include bay pipefish (*Syngnathus leptorhynchus*), splittail, Pacific herring, California roach, threespine stickleback, common carp, and inland silverside (*Menidia beryllina*) (Brown and Caldwell/Jones and Stokes Associates 1994).

Adobe Creek is a major tributary of the Petaluma River and formerly provided important migration, spawning, and rearing habitat for steelhead trout. Presently, some resident rainbow trout are believed to persist in parts of Adobe Creek, but regular runs of spawning steelhead no longer occur there (Bill Cox, California Department of Fish and Game fisheries biologist, Region 3 Yountville, personal communication, 1994). In addition, Adobe Creek probably supports other native and non-native fish species that are more tolerant of warm water and low dissolved oxygen conditions than are adult and juvenile steelhead trout (Brown & Caldwell/Jones & Stokes Associates 1994).

The Petaluma River and Sonoma Creek drain into San Pablo Bay. Because of its location, San Pablo Bay is a region of transition between the marine habitats of the ocean and the freshwater habitats of its tributaries. Water movements in San Pablo Bay result primarily from tidal currents as ocean waters enter and leave through the Golden Gate. These currents remain relatively constant throughout the year, although they are influenced by freshwater flood flows and winds. Currents are strongest in the deepwater channel that runs through the center of San Pablo Bay.

San Pablo Bay is part of the San Francisco Bay Delta System (Bay System), which is generally regarded as the most important aquatic ecosystem in California (EIP 1990). It is used extensively for both recreational and commercial purposes. About 40 percent of the land area of California drains into the Bay System. Since the turn of the century, freshwater inflow to the Bay System has diminished as large quantities of water are diverted and exported to the San Joaquin Valley and Southern California for urban and agricultural uses (EIP 1990).

The bay lands area, located north of San Pablo Bay, was formerly part of an interconnected system of seasonal wetlands and tidal marshes. The remaining seasonal wetlands, tidal marshes, and adjacent salt marshes provide essential habitat for migratory waterfowl and several special-status wildlife species. Many of these tidal areas are now surrounded by levees and have been drained for agriculture. Agricultural fields, channels, and levees support most of the remaining plant communities which contain native plant species or provide wildlife habitat (see bay lands description under South County Geographic Area, Section 4.8, Terrestrial Biological Resources for further information). Most of the seasonal wetlands in the bay lands area are located south of State Highway 37 in close proximity to San Pablo Bay and the Petaluma River. The seasonal wetlands north of State Highway 37 have been greatly reduced and degraded, but are used by migratory waterfowl, wading birds, and shorebirds during high rainfall years (e.g., 1983 and 1995) (Laurel Marcus, California Coastal Conservancy, personal communication, February 20, 1996).

Sebastopol

There are two major watersheds within the Sebastopol geographic area. One of these watersheds is drained by Green Valley Creek and Atascadero Creek, while the other is drained by the Laguna de Santa Rosa. The Laguna de Santa Rosa and its major tributaries are described under the Santa Rosa Plain/Russian River geographic area.

Green Valley Creek is a small stream system that enters the Russian River about one mile downstream from the mouth of the Laguna de Santa Rosa. Recent habitat and fish surveys indicate that only a small portion of Green Valley Creek (near Green Valley Creek Road) still contains habitat adequate for salmonid

spawning and rearing. Green Valley Creek supports small runs of steelhead trout and coho salmon and has a resident population of the federally endangered California freshwater shrimp (Merritt Smith Consulting 1996a).

Atascadero Creek, located at the western boundary of Sebastopol, is part of a larger watershed that includes Green Valley Creek and Atascadero Marsh (PAS & Associates 1992). Atascadero Creek is the main tributary feeding into Green Valley Creek. Recent California Department of Fish and Game fish surveys indicate that some steelhead trout and coho salmon spawning and rearing habitat occurs in Atascadero Creek and its tributary, Jonive Creek, at Ragle Regional Park (Bill Cox, California Department of Fish and Game fisheries biologist, Region 3 Yountville, personal communication, 1994).

Geysers

The main drainage associated with the geysers geographic area is Big Sulphur Creek. However, several smaller tributaries, including Anna Belcher Creek, Little Sulphur Creek, Cobb Creek, Squaw Creek, Hurley Creek, Deer Creek, Sausal Creek, Hoot Owl Creek, Maacama Creek, Franz Creek, Brooks Creek, and Pool Creek, are also present within the geysers reserve and proposed pipeline route. The following habitat characterization of Big Sulphur Creek is based upon stream crossing assessments conducted by fisheries biologists along those areas of the streams that are proposed to be crossed by Project pipelines (Merritt Smith Consulting 1996c).

Big Sulphur Creek is a perennial stream that originates in the southern portion of the geysers reserve, flows in a northwesterly direction through northeastern Sonoma County and empties into the Russian River. Most of the watershed is steep and forested (Environmental Science Associates 1994). Big Sulphur Creek has suitable habitat for special-status aquatic animal species including foothill yellow-legged frog, Russian River tule perch, California red-legged frog, northwestern pond turtle, hardhead, coho salmon, and steelhead trout (Merritt Smith Consulting 1996b, Merritt Smith Consulting 1996c, Merritt Smith Consulting 1996d). The aquatic biological resources of the smaller tributaries (within surveyed sections) of the geysers area are summarized in the *Stream Crossings Assessment* Technical Memorandum (Merritt Smith Consulting 1996c).

Regulatory Framework

The regulatory framework that provides the policies and regulations governing impacts to aquatic biological resources within the Area of Indirect Impacts is equivalent to that for Terrestrial Biological Resources presented in Section 4.8.

In addition, the National Oceanic and Atmospheric Administration (NOAA) has administrative authority over the Gulf of the Farallones National Marine Sanctuary. This sanctuary was designated under Section 302(a) of Title III of the Marine Protection, Research and Sanctuaries Act of 1972. The sanctuary encompasses an area of the waters adjacent to the coast of California north and south of the Point Reyes Headlands, between Bodega Head and Rocky Point and the Farallone Islands (including Noonday Rocks). NOAA is a cooperating agency in the preparation of this EIR/EIS.

EVALUATION CRITERIA WITH POINT OF SIGNIFICANCE

Table 4.9-3

Evaluation Criteria with Point of Significance - Aquatic Biological Resources

Evaluation Criteria	As Measured by	Point of Significance	Justification
1. Will the Project cause loss of individuals or occupied habitat of endangered, threatened, or rare aquatic wildlife or plant species[1]?	a) Number of individuals that will be lost b) Acres of occupied or critical habitat lost	a) Greater than 0 individuals b) Greater than 0 acres	FESA, CESA (Sections 2062 and 2067), CEQA (Article 5, Section 15065), and California Native Plant Protection Act (CDFG Code Sections 1900-1913)
2. Will the Project cause loss of individuals of CNPS List 2, 3, or 4 aquatic plant species?	Number of species that will experience a loss of individuals	Greater than 15 percent of known occurrences in Sonoma and Marin counties	California Native Plant Protection Act (CDFG Code Sections 1900-1913), CEQA (Article 5, Section 15065), Caitlin Bean, Biologist, CDFG, Yountville, meeting January 1994.
3. Will the Project cause loss of potential or occupied habitat of aquatic species of aquatic wildlife concern?	Acres of potential or occupied habitat lost	Greater than 20 percent of potential habitat in local watershed	FESA, CESA (Sections 2062 and 2067), CEQA (Article 5, Section 15065), and California Native Plant Protection Act (CDFG Code Sections 1900-1913)

Table 4.9-3

Evaluation Criteria with Point of Significance - Aquatic Biological Resources

Evaluation Criteria	As Measured by	Point of Significance	Justification
4. Will the Project cause permanent loss of sensitive aquatic plant communities and associated wildlife habitats (i.e., freshwater marsh, brackish marsh, vernal pools)?	Acres of sensitive aquatic plant communities lost	Greater than 0 acres	CEQA (Article 5, Section 15065), California Native Plant Protection Act (Fish and Game Code, Sections 1900-1913), See Also Jurisdictional Wetlands Section 4.10, CDFG (CNDDB 1994, 1995)
5. Will the Project cause permanent loss of aquatic habitat (i.e., streams and ponds)?	a) Linear feet of coolwater Type A and coolwater Type B stream habitat permanently lost b) Linear feet of warmwater Type A stream habitat permanently lost c) Linear feet of warmwater Type B stream habitat permanently lost and d) Acres of pond habitat permanently lost	a) Greater than 0 linear feet b) Greater than 15% of habitat type in local watershed (linear feet and acreage respectively) c and d) Greater than 25% of habitat type in local watershed (linear feet and acreage respectively)	CEQA (Article 5, Section 15065), with concurrence from Bill Cox (CDFG fisheries biologist, Region 3 [Yountville]) Note: See Criterion #1 of Jurisdictional Wetlands Section
6. Will the Project cause a change to the physical condition of aquatic habitat in the Estero Americano or Estero de San Antonio within the Gulf of the Farallones National Marine Sanctuary?	Change in salinity[4] in parts per thousand (ppt) in the Esteros	Greater than 0 ppt salinity change	National Marine Sanctuaries Act (16 U.S.C. 1436), National Oceanic and Atmospheric Administration (15 CFR 922), CEQA (Article 5, Section 15065)
7. Will the Project substantially block or disrupt major fish or aquatic wildlife migration or travel corridors?	Number of corridors substantially blocked or disrupted	Greater than 0 corridors	CEQA (Appendix G)

Table 4.9-3

Evaluation Criteria with Point of Significance - Aquatic Biological Resources

Evaluation Criteria	As Measured by	Point of Significance	Justification
8. Will the Project cause a decrease in streamflows, affecting aquatic habitat or aquatic life downstream from proposed dam sites?	Linear feet of warmwater stream habitat where 50 percent decrease in wet season streamflow or any decrease in dry season streamflow occurs	Greater than 0 linear feet Greater than 0 linear feet	CEQA (Article 5, Section 15065)
9. Will the Project result in ecological risk to aquatic plant and wildlife populations (i.e., acute or chronic toxicity and bioaccumulation)?	Ecological quotient[2] (EQ)	EQ Greater than 10	Menzie et al. 1993

Source: Harland Bartholomew & Associates, Inc., 1996

Notes:

CDFG California Department of Fish and Game
CNPS California Native Plant Society
USFWS United States Fish and Wildlife Service
FESA Federal Endangered Species Act
CESA California Endangered Species Act
CEQA California Environmental Quality Act

1. Endangered, threatened, or rare is defined here as:
   - federally listed endangered, threatened, or proposed plant or wildlife species
   - state listed endangered, threatened, rare or proposed plant or wildlife species
   - federal candidates for listing
   - CNPS List 1B plant species
2. Species of concern wildlife are defined here as:
   - wildlife designated as "species of special concern" by the California Department of Fish and Game
   - wildlife listed as "fully protected" in California
3. Ecological quotient is the ratio of the exposure concentration or exposure rate to the appropriate benchmark value (i.e., reference values for potential effects on site organisms).
4. Salinity is measured by total dissolved solids, which measures all of the salts.

METHODOLOGY

The following section provides a brief discussion of the survey and analytical methodologies utilized in assessing aquatic biological resource impacts within the Area of Direct Impacts and Area of Indirect Impacts. *Biological Resources, Volume 1* provides a more detailed description of specific survey methodologies and survey results (Harland Bartholomew & Associates, Inc. 1996a).

Aquatic biological resources potentially impacted by Project actions were identified through literature review, California Natural Diversity Data Base (CNDDB) record searches, consultation with natural resource experts, and field surveys. The CNDDB contains occurrence records for special-status plant and animal species, as well as sensitive natural vegetation communities. Special-status aquatic species include:

- those plants and animals that are legally protected, proposed, or candidates for protection under the California Endangered Species Act (CESA) and Federal Endangered Species Act (FESA);
- plants and animals defined as endangered or rare under the California Environmental Quality Act (CEQA);
- animals designated as "species of special concern" by the California Department of Fish and Game;
- animals listed as "fully protected" in California (Fish and Game Code Sections 3511, 4700, 5050); and
- plants identified and classified in the California Native Plant Society's (CNPS) *Inventory of Rare and Endangered Vascular Plants of California* (1994).

CNDDB record searches were conducted in 1994 and 1995 for each 7.5 minute USGS quadrangle that contains portions of the Area of Indirect Impacts. In addition, resource agency representatives U.S. Fish and Wildlife Service, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, the California Department of Fish and Game, and local natural resource experts (e.g., Sierra Club - Sonoma Group, Marin Conservation League, Resource Conservation League of Sonoma, Marin and Madrone Chapters of the National Audubon Society, and the Russian River Watershed Protection Committee, California Native Plant Society) were consulted to acquire available occurrence data.

Field surveys were conducted at the site of Project components in order to describe, inventory, and map the existing aquatic biological resources. The results of CNDDB record searches, field observations, and field mapping of aquatic biological resources were entered into a Geographic Information System (GIS) data base. Acreage and locations of vegetation communities, wetlands, and wildlife habitats, and number and location of special-status species occurrences present within the construction zone

boundary of each Project component were generated. These data were then used to describe the existing conditions for aquatic biological resources and evaluate potential impacts to these resources. For a more thorough discussion of analytical methods refer to *Biological Resources, Volume 1* (Harland Bartholomew & Associates, Inc. 1996a).

In conducting aquatic habitat assessments, the aquatic resource was mapped as a stream, pond, or estuary. Habitats were classified into one of six categories, four that apply to streams, one to ponds, and one to estuaries. The four stream categories are coolwater A, coolwater B, warmwater A, and warmwater B. The pond category includes perennial standing water bodies of any size, including irrigation and stock ponds, as well as existing municipal reservoirs. The Estero Americano and Estero de San Antonio were included under the estuary category. Each of these habitat categories is described in detail and depicted on maps in *Aquatic Habitat Survey Results* (Merritt Smith Consulting 1996b).

Plant surveys, vegetation community mapping, and wildlife habitat mapping are described in the Methodology Section of Terrestrial Biological Resources, Section 4.8. Survey methodologies specific to aquatic biological resources are briefly summarized below.

Storage Reservoir Sites

Aquatic biological resource surveys were conducted at each of the 10 storage reservoirs. Aquatic biologists visually surveyed streams within the construction zone of each storage reservoir, including the reservoir site, construction areas, and areas of ancillary structures and access roads.

Aquatic Habitat/Aquatic Life Surveys

Streams associated with the storage reservoirs were assessed to determine the quality of aquatic habitat and to sample the existing aquatic fauna (Merritt Smith Consulting 1996d). These surveys were conducted from May 1994 through August 1995. The aquatic habitat found at each survey site was examined and sampled, but particular emphasis was placed on the least degraded sections of the streams (i.e., habitat most likely to support special-status species and high faunal diversity of native species). In areas where access was not permitted, stream habitat assessments usually consisted of observations made from bridges at public road crossings. In accessible areas, more extensive stream habitat surveys were conducted. These latter surveys consisted of visual descriptions (including photographs of each site) and estimates of important habitat elements including stream flow (in cubic feet per second, based on professional judgment), substrate, vegetation, and level of disturbance (Merritt Smith Consulting 1996b). While traversing the stream, the habitat features associated with each surveyed stream segment were recorded on a standard inventory form. Careful visual searches for special-status aquatic animal species and an assessment of suitable habitat for

these species were also conducted concurrently with the general habitat surveys. Observations were recorded on standardized data sheets. Maps of the habitats observed can be found in *Aquatic Habitat Survey Results* (Harland Bartholomew & Associates, Inc. 1996d).

All streams associated with the storage reservoirs were intensively sampled for aquatic wildlife species during May 1995 (Merritt Smith Consultants 1996b). The stream habitat types found at each survey site were sampled for invertebrates and vertebrates. This sampling was conducted by two fisheries biologists using either a seine (a large fishing net with floats along the top and weights along the bottom) or dipnet. The majority of captured organisms were quickly identified and released at the capture site. Voucher specimens were collected in some cases for later microscopic examination and identification in the laboratory. All vertebrate and invertebrate aquatic species captured were catalogued. Surveys to determine the presence of special-status species at sampling locations and the likelihood of special-status species occurring downstream of sampling locations were conducted (Merritt Smith Consulting 1996d). This information was recorded on standardized field inventory forms.

Special-Status Species Surveys

Focused surveys were conducted for all state and federally listed, proposed, and candidate endangered and threatened aquatic wildlife species that could potentially be impacted by the construction and operation of storage reservoirs. Those species requiring focused surveys included California red-legged frog, California freshwater shrimp, vernal pool fairy shrimp, longhorn fairy shrimp, Conservancy fairy shrimp, and vernal pool tadpole shrimp, California tiger salamander, northwestern pond turtle, Tomales isopod, California linderiella and foothill yellow-legged frog. Surveys for federal candidate species with similar habitat requirements (e.g., California tiger salamander, northwestern pond turtle, Tomales isopod, California linderiella, and foothill yellow-legged frog) were conducted concurrently with the focused surveys. The federal status of California linderiella, northwestern pond turtle, Tomales isopod, and foothill yellow-legged frog changed in March 1996. All were dropped from the United States Fish and Wildlife Service candidate species list. The analysis was altered to reflect this change. Established protocols developed by the United States Fish and Wildlife Service, California Department of Fish and Game, and Larry Serpa were utilized by qualified wildlife biologists (i.e., possessing at least a Bachelor's degree in biology, wildlife and fisheries biology, zoology, or other related natural resources field; field experience with special-status species; and possession of current appropriate scientific collecting permits from California Department of Fish and Game and United States Fish and Wildlife Service). These protocols are identified in Table 4.9-4.

Table 4.9-4

Special-Status Species Survey Methodologies

Species	Protocol Date	Comments
Vernal pool crustaceans	January 19, 1995	Developed by USFWS
California freshwater shrimp	1991	Informal protocol developed by Larry Serpa, Nature Conservancy entomologist, and approved by CDFG and USFWS
California tiger salamander, foothill yellow-legged frog, and California red-legged frog	April 26, 1994	Informal protocol developed by John Brode, staff herpetologist, CDFG, in discussions with HBA biologists

Source: Harland Bartholomew & Associates, Inc. 1996

Following the first heavy rains of the year (late November 1994), all reservoir sites were assessed for the presence of vernal pools. In areas where vernal pools were identified, a wet sampling series for special-status vernal pool crustaceans was conducted by United States Fish and Wildlife Service-permitted wildlife biologists in accordance with United States Fish and Wildlife Service guidelines (United States Fish and Wildlife Service January 19, 1995). California tiger salamander surveys were conducted concurrently with the vernal pool crustacean surveys according to the informal protocol developed by the California Department of Fish and Game (April 26, 1994). Vernal pools were sampled once every two weeks until the pools dried in late spring (i.e., late November 1994 through early May 1995). Refer to *Biological Resources, Volume 1* (Harland Bartholomew & Associates, Inc. 1996a) for a more detailed discussion of this protocol.

Suitable habitat containing a permanent source of water was surveyed for both California freshwater shrimp and Tomales isopod. All fair, good, or excellent habitat was sampled for the shrimp and isopod. Habitat quality was rated by a combination of features known to be important to the shrimp, including water depth, presence or absence of undercut banks, and the quality and quantity of tree roots and herbaceous vegetation hanging into the water (Serpa 1995). Sampling of aquatic invertebrates was conducted by vigorously disturbing the vegetation below the waterline and collecting with submerged aerial insect nets. These surveys were completed in a single site visit during the week of August 21 to August 25, 1995. Refer to the *Survey for the California Freshwater Shrimp at*

Proposed Reservoir Sites for more details on methods and results associated with these surveys (Serpa 1996).

California red-legged frog and foothill yellow-legged frog surveys were conducted simultaneously. Surveys consisted of an initial habitat assessment and subsequent night-time survey at areas determined to have suitable habitat. The goal of the habitat assessment was to identify the quality, extent, and location of potential habitat in preparation for the night-time surveys. The primary goal of the night-time surveys was to determine whether red-legged frogs or yellow-legged frogs currently occur at the storage reservoir sites. These surveys followed the informal protocol developed by the California Department of Fish and Game (April 26, 1994). Refer to *Biological Resources, Volume 1* for a more detailed discussion (Harland Bartholomew & Associates, Inc. 1996a).

Suitable habitat for red-legged frog and yellow-legged frog is also suitable for northwestern pond turtle. Surveys for northwestern pond turtle were conducted during the daytime habitat assessments for red-legged frog and yellow-legged frog. These surveys consisted of scanning (with binoculars) for turtles in suitable habitat within and along streams and stock ponds. All observations were recorded on data sheets and aerial photographs.

Agricultural Irrigation Areas

Due to the large acreage associated with the agricultural irrigation areas and limited permissible site access, single-visit surveys (often performed from adjacent public rights-of-way) were conducted for aquatic wildlife species and aquatic wildlife habitat. Due to the homogeneity of the agricultural irrigation areas, these surveys are considered adequate to provide a general characterization of streams. Aquatic habitat within irrigation areas was assessed utilizing methodologies similar to those presented in the aquatic life surveys for storage reservoirs.

A more detailed description of survey methodologies can be found in *Biological Resources, Volume I* (Harland Bartholomew & Associates, Inc. 1996a) and *Aquatic Habitat Survey Results* (Merritt Smith Consulting 1996b).

Pipelines

All stream crossings along the pipeline alignments were assessed for their aquatic habitat quality. Surveys were conducted from June 12 to August 3, 1995 (Merritt Smith Consulting 1996c). The surveys were conducted following the end of a wet winter with record rainfall. As a consequence there were persistent flows in many of the streams that will normally be expected to be dry during the summer months. Surveys were conducted at all stream crossings with suitable habitat and flow to support aquatic life, but were conducted without entering the streams. The data collection forms were therefore developed to describe the aquatic habitat at pipeline crossings with this constraint in

mind. Limited permissible access prohibited the kind of in-stream surveys typically conducted for this type of analysis (Merritt Smith Consulting 1996c). In most cases, the surveys were conducted from the bridge crossing the streams in the public road right-of-way. However, the information collected on the forms (e.g., permanence, type of substrate, embeddedness, in-stream shelter, and percent canopy closure) provides an effective method for characterizing aquatic habitat given the restrictions of access (Merritt Smith Consulting 1996c). The locations for all of the identified stream crossings are shown in Maps E-1 through E-21 of *Biological Resources, Volume 4E* (Harland Bartholomew & Associates, Inc. 1996f).

Ecological Risk Assessment

An ecological risk assessment of representative scenarios under the various Project alternatives was undertaken to evaluate potential adverse effects to ecological resources as a result of exposure to chemical constituents in reclaimed water. The primary objective of the ecological risk assessment was to identify and characterize the potential risks posed to environmental receptors (i.e., individual species) as a result of the alternative uses of the reclaimed water.

Two main routes of exposure were identified for evaluation of ecological risk to terrestrial and aquatic organisms due to the implementation of the Project: direct contact with the media (surface soil, water, and sediment) and indirect exposure by dietary intake. Specific ecological receptors were selected to evaluate potential effects on aquatic biota and wildlife exposure through food ingestion. Key ecological receptors, representative of various trophic levels, were evaluated, including red-legged frog, steelhead trout, mallard duck, harbor seal, and great blue heron. Ecological receptors are species which potentially could be exposed to the chemical constituents of concern.

Monitoring data for reclaimed water of the Laguna Plant storage ponds were used as the basis for assessment of ecological risk assessment to aquatic organisms in for reclaimed water storage. This approach assumes that future water quality in the reservoirs will be similar to the current reclaimed water quality in the storage ponds. Water quality data were evaluated in terms of potential effects on aquatic organisms (including amphibians) by direct exposure. The assessment of potential effects associated with exposure to sediments in storage reservoirs was based on the use of monitoring data for existing reclaimed water storage ponds of the Santa Rosa water reclamation facility. This approach assumes that future sediment conditions in the reservoirs will be similar to, or better than, those in existing ponds because reclaimed water quality has improved in recent years and will be maintained following implementation of the Project.

The assessment of ecological risk was based on the calculation of the ecological quotients (EQs). The quotient is calculated as the ratio between exposure concentration for a given chemical substance and an applicable benchmark value that identifies possible adverse effect levels on ecological receptors. The characterization of potential effects on receptor

organisms was based on the following guidelines (EPA 1989; Watkins and Stelljes 1993; Menzie et al., 1993):

1. Adverse effects are not expected for EQ values equal to, or less than, 1;
2. A low potential for environmental effects is indicated by an EQ value between 1 and 10;
3. A significant potential for adverse effects is indicated by an EQ value greater than 10; and
4. EQs in excess of 100 identify a very high probability for adverse effects on ecological receptors and biological communities.

Six major pathways were identified for the potential exposure of aquatic organisms and wildlife to the reclaimed water: 1) direct exposure to the reclaimed water in Santa Rosa Creek and the Laguna de Santa Rosa; 2) exposure of organisms associated with the Russian River at 1 percent, 5 percent, 10 percent, and 20 percent Russian River Discharge with Russian River and Laguna discharge sites; 3) exposure of rooted vegetation, benthic organisms, and waterfowl to sediments in the Laguna de Santa Rosa and the Russian River; 4) exposure of aquatic and terrestrial vegetation by reclaimed water application to irrigation fields; and 6) potential releases from pipelines along the transfer route to the geysers injection area. Exposure risks include effects of existing discharges along the Russian River. For more detailed information on the ecological risk assessment methodology and results, see the *Ecological Risk Assessment* (Parsons Engineering Science, Inc. 1996).

ENVIRONMENTAL CONSEQUENCES (IMPACTS) AND RECOMMENDED MITIGATION

No Action (No Project) Alternative

Table 4.9-5

Aquatic Biological Resources Impacts by Component - No Action Alternative

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
9.1.1. Will the pipeline component cause loss of individuals or occupied habitat of endangered, threatened or rare aquatic wildlife or plant species?	a) Greater than 0 species and b) Greater than 0 acres	None	C	==

Table 4.9-5

Aquatic Biological Resources Impacts by Component - No Action Alternative

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
9.1.2. Will the pipeline component cause loss of individuals of CNPS List 2, 3, or 4 aquatic plant species?	Greater than 15% of existing occurrences or populations in Sonoma and Marin counties	None	C	==
9.1.3. Will the pipeline component cause loss of potential or occupied habitat of aquatic wildlife species of concern?	Greater than 20% of potential habitat in local watershed	None	C	==
9.1.4. Will the pipeline component cause a permanent loss of sensitive native aquatic plant communities?	Greater than 0 acres	None	C	==
9.1.5. Will the pipeline component cause a permanent loss of aquatic habitat and associated wetlands?	Greater than 15% of warmwater A habitat; or Greater than 25% of warmwater B or pond habitat	None	C	==
9.1.6. Will the pipeline component cause a change in the physical condition of aquatic habitat in the Estero Americano or the Estero de San Antonio within the Gulf of the Farallones National Marine Sanctuary?	Greater than 0 parts per thousand salinity change	None	C	==
9.1.7. Will the pipeline component substantially block or disrupt major fish or aquatic wildlife migration or travel corridors?	Greater than 0 corridors	None	C	==
9.1.8. Will the pipeline component cause a decrease in streamflows, affecting aquatic habitat or aquatic life downstream from proposed dam sites?	Greater than 0 linear feet	None	C	==

Table 4.9-5

Aquatic Biological Resources Impacts by Component - No Action Alternative

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
9.1.9. Will the pipeline component result in ecological risk to terrestrial plant and wildlife populations (i.e., acute or chronic toxicity and bioaccumulation)?	Ecological Quotient (EQ) greater than 10	EQ values range from 0.0 to 4.64	O&M	❍

Source: Harland Bartholomew & Associates, Inc., 1996

Notes:
1. Type of Impact:
   - C Construction
   - O&M Operation and Maintenance
   - -- Not Applicable
   - P Permanent
2. Level of Significance:
   - ❍ Less than significant impact; no mitigation proposed
   - ⊙ Significant impact before mitigation; less than significant impact after mitigation
   - ═ No Impact

Impact: **9.1.1-8. Will the No Action Alternative impact aquatic biological resources based on evaluation criteria 1 through 8?**

Analysis: *No Impact; Alternative 1.*

There will be no construction of facilities under the No Action (No Project) Alternative. Therefore, Alternative 1 will not affect aquatic habitat.

Mitigation: No mitigation is needed.

Impact: **9.1.9. Will the No Action Alternative result in ecological risk to aquatic plant and wildlife populations (i.e., acute or chronic toxicity and bioaccumulation)?**

Analysis: *Less than Significant; Alternative 1.*

Continued or increased discharge through the Laguna to the Russian River will result in an increased ecological risk, EQ ranging from 0.0 to 4.64, which is slightly higher than the current discharge but well below the point of significance (EQ>10).

Mitigation: No mitigation is proposed.

Headworks Expansion Component

Impact: **9.2.1-9. Will the headworks expansion component impact aquatic biological resources based on evaluation criteria 1 through 9.**

Analysis: *No Impact; All Alternatives.*

The headworks expansion will be accomplished by replacing the existing pumps with six new higher-capacity pumps. This process will not require additional land and as a consequence no new impacts are expected to occur. There will be no impact to aquatic biological resources associated with the headworks expansion.

Alternative 1 does not have a headworks expansion component.

Mitigation: No mitigation is needed.

Urban Irrigation Component

Impact: **9.3.1-9. Will the urban irrigation component impact aquatic biological resources based on evaluation criteria 1 through 9?**

Analysis: *No Impact; All Alternatives.*

The acreage and rate of application of irrigation water at the urban irrigation sites will remain the same. The only change will be associated with the source of the irrigation water. Currently, these sites are supplied with water from wells and city water. The Project will provide for the use of reclaimed water. Since both the rate of application and the area irrigated will not change as a result of this Project, there will be no impacts to aquatic biological resources.

Alternatives 1, 4, and 5 do not have an urban irrigation component.

Mitigation: No mitigation is needed.

Pipeline Component

Table 4.9-6

Aquatic Biological Resources Impacts by Component - Pipelines

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
9.4.1. Will the pipeline component cause loss of individuals or occupied habitat of endangered, threatened or rare aquatic wildlife or plant species?	a. Greater than 0 species and b. Greater than 0 acres	None	C	==
9.4.2. Will the pipeline component cause loss of individuals of CNPS List 2, 3, or 4 aquatic plant species?	Greater than 15% of existing occurrences or populations in Sonoma and Marin counties	None	C	==
9.4.3. Will the pipeline component cause loss of potential or occupied habitat of aquatic wildlife species of concern?	Greater than 20% of potential habitat in local watershed	None	C	==
9.4.4. Will the pipeline component cause a permanent loss of sensitive native aquatic plant communities?	Greater than 0 acres	None	C	==
9.4.5. Will the pipeline component cause a permanent loss of aquatic habitat and associated wetlands?	Greater than 15% of warmwater A habitat; or Greater than 25% of warmwater B or pond habitat	None	C	==
9.4.6. Will the pipeline component cause a change in the physical condition of aquatic habitat in the Estero Americano or the Estero de San Antonio within the Gulf of the Farallones National Marine Sanctuary?	Greater than 0 parts per thousand salinity change	None	C	==

Table 4.9-6

Aquatic Biological Resources Impacts by Component - Pipelines

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
9.4.7. Will the pipeline component substantially block or disrupt major fish or aquatic wildlife migration or travel corridors?	Greater than 0 corridors	None	C	==
9.4.8. Will the pipeline component cause a decrease in streamflows, affecting aquatic habitat or aquatic life downstream from proposed dam sites?	Greater than 0 linear feet	None	C	==
9.4.9. Will the pipeline component result in ecological risk to aquatic plant and wildlife populations (i.e., acute or chronic toxicity and bioaccumulation)?	Ecological Quotient (EQ) greater than 10	EQ values range from 0.04 to 1.44	O&M	○

Source: Harland Bartholomew & Associates, Inc., 1996

Notes: 1. Type of Impact:
C Construction
O&M Operation and Maintenance

2. Level of Significance:
○ Less than significant impact; no mitigation proposed
== No Impact

Impact: **9.4.1-8. Will the pipeline component impact aquatic biological resources based on evaluation criteria 1 through 8?**

Analysis: *No Impact; All Alternatives.*

Though special-status species and sensitive aquatic plant communities are potentially present within pipeline construction corridors, final pipeline locations will avoid all occupied habitats.

Results of habitat assessments on and adjacent to the pipeline locations indicate that many of the current pipeline locations provide suitable habitat for a variety of endangered, threatened, rare or other sensitive aquatic plant and wildlife resources. Table 4.9-6 presents the width of streams (linear feet) potentially impacted by pipeline construction and that may support special-status species. See *The Stream Crossings Assessment* for more information (Merritt Smith Consulting 1996c). Table 4.9-7 presents

sensitive aquatic plant communities located along the current pipeline alignments. The point locations for sensitive native aquatic plant communities found along the pipeline routes are identified on maps bound in *Biological Resources, Volume 4E* (Harland Bartholomew & Associates, Inc. 1996g). Table 4.9-8 presents a summary of aquatic habitat crossed by pipelines.

Measure 2.2.5, Avoid Sensitive Biological Resources, adopted as part of the Project, establishes procedures for avoidance of construction impacts to sensitive aquatic wildlife or plant species, their habitats and sensitive aquatic plant communities. Preconstruction surveys will be conducted for sensitive biological resources prior to final Project design. Project siting and design will provide avoidance of these resources through realignment of pipelines and establishment of associated exclusionary buffers where no activity will be allowed.

The pipelines will not cause a change in the physical condition of aquatic habitat in the Estero Americano and Estero de San Antonio since the construction zones are located well outside the National Marine Sanctuary and there will be no impact to the esteros.

Measure 2.2.5 establishes that no construction will occur within a perennial stream and construction in ephemeral streams will occur in the dry season and be temporary in nature. Therefore, there is no potential for pipelines to substantially block or disrupt major fish travel or affect stream flows.

Table 4.9-7

Pipeline Stream Crossings Potentially Supporting Sensitive Aquatic Wildlife Species

Alternatives	Perennial (linear feet in width of stream crossing)	Seasonal/Intermittent (linear feet in width of stream crossing)
Alternative 2A	74 linear feet (2 crossings)	659 linear feet (15 crossings)
Alternative 2B	74 linear feet (2 crossings)	659 linear feet (15 crossings)
Alternative 2C	74 linear feet (2 crossings)	659 linear feet (15 crossings)

Table 4.9-7

Pipeline Stream Crossings Potentially Supporting Sensitive Aquatic Wildlife Species

Alternatives	Perennial (linear feet in width of stream crossing)	Seasonal/Intermittent (linear feet in width of stream crossing)
Alternative 2D	74 linear feet (2 crossings)	659 linear feet (15 crossings)
Alternative 3A	2,364 linear feet (5 crossings)	220 linear feet (9 crossings)
Alternative 3B	2,274 linear feet (5 crossings)	225 linear feet (9 crossings)
Alternative 3C	2,364 linear feet (5 crossings)	220 linear feet (9 crossings)
Alternative 3D	2,364 linear feet (5 crossings)	220 linear feet (9 crossings)
Alternative 3E	2,364 linear feet (5 crossings)	220 linear feet (9 crossings)
Alternative 4	480 linear feet (8 crossings)	124 linear feet (7 crossings)
Alternative 5A	15 linear feet (1 crossings)	0 linear feet (0 crossings)

Source: Harland Bartholomew and Associates, Inc., 1996

Table 4.9-8

Sensitive Aquatic Plant Communities Identified in Pipeline Construction Corridors to Be Avoided

Alternatives	Pipeline Segments	Brackish Marsh (Acres)	Vernal Pools (Acres)
Alternative 2A	S-16 (South County)	0	0.04
Alternative 2B	S-16 (South County)	0	0.04
Alternative 2C	S-16 (South County)	0	0.04
Alternative 2D	S-16 (South County)	0	0.04
Alternative 3A	W-128 (West County)	0.96	0
Alternative 3B	W-128 (West County)	0.96	0
Alternative 3C	W-128 (West County)	0.96	0
Alternative 3D	W-128 (West County)	0.96	0
Alternative 3E	W-128 (West County)	0.96	0
Alternative 4	--	0	0
Alternative 5A	--	0	0

Source: Harland Bartholomew & Associates, Inc., 1996

Table 4.9-9

Summary of Identified Aquatic Habitat Crossed by Pipelines

Alternatives	Perennial (linear feet of stream crossing)	Seasonal/Intermittent (linear feet of stream crossing)
Alternative 2A	464 linear feet (9 crossings)	11,918 linear feet (61 crossings)
Alternative 2B	464 linear feet (9 crossings)	11,056 linear feet (28 crossings)
Alternative 2C	464 linear feet (crossings)	12,062 linear feet (152 crossings)
Alternative 2D	74 linear feet (14 crossings)	374 linear feet (16 crossings)

Table 4.9-9

Summary of Identified Aquatic Habitat Crossed by Pipelines

Alternatives	Perennial (linear feet of stream crossing)	Seasonal/Intermittent (linear feet of stream crossing)
Alternative 3A	2,761 linear feet (14 crossings)	3,676 linear feet (143 crossings)
Alternative 3B	2,621 linear feet (13 crossings)	3,311 linear feet (46 crossings)
Alternative 3C	2,761 linear feet (14 crossings)	5,591 linear feet (157 crossings)
Alternative 3D	2,704 linear feet (12 crossings)	3,426 linear feet (152 crossings)
Alternative 3E	2,704 linear feet (12 crossings)	3,434 linear feet (153 crossings)
Alternative 4	420 linear feet (9 crossings)	6,858 linear feet (147 crossings)
Alternative 5A	270 linear feet (3 crossings)	6 linear feet (2 crossings)

Source: Harland Bartholomew & Associates, Inc., 1996

Alternatives 1 and 5B do not have a pipeline component.

Mitigation: No additional mitigation is needed.

Impact: 9.4.9. Will the pipeline component result in ecological risk to aquatic plant and wildlife populations (i.e., acute or chronic toxicity and bioaccumulation)?

Analysis: *Less than Significant; Alternatives 2, 3, 4, and 5A.*

Rupture of pipelines could occur due to earthquakes along irrigation or geysers pipelines and could result in acute exposure of aquatic organisms to chemical constituents of the reclaimed water. This analysis addresses the risk of short-term exposure of freshwater organisms to reclaimed water constituents in creeks along either the geysers pipeline alignment or irrigation pipelines (*Ecological Risk Assessment* Parsons Engineering Science, Inc. 1996).

These scenarios are based on the assumption that undiluted reclaimed water is discharged to streams on an occasional basis without a significant dilution from the receiving waters. Consequently, the risk evaluation was based on short-term (i.e., acute) exposure of aquatic organisms to reclaimed water constituents. No chronic exposure or bioaccumulation will be expected to occur.

For all organic and inorganic chemicals detected in the effluent, calculated Ecological Quotient (EQ) values (i.e., $0.04 \leq EQ \leq 1.44$) [the EQ is greater than or equal to 0.04 but less than or equal to 1.44] were below the threshold value of 10 indicative of potential significant adverse effects on freshwater organisms. Any potential impacts will therefore be less than significant.

No Impact; Alternatives 1 and 5B.

These alternatives do not have a pipeline component.

Mitigation: No additional mitigation is proposed.

Storage Reservoir Component

The storage reservoir component table is presented as a separate table for each criterion to present the information more clearly.

Table 4.9-10

Aquatic Biological Resources Impacts by Component - Storage Reservoirs, Criterion #1

Evaluation Criteria	Point of Significance	Impact[1]		Type of Impact[2]	Level of Significance[3]
9.5.1. Will the storage reservoir component may cause loss of individuals or occupied habitat of endangered, threatened, or rare aquatic wildlife or plant species?	a) Greater than 0 individuals b) Greater than 0 acres of occupied habitat				
California red-legged frog		**Individuals**	**Acres**		
• Tolay Extended		2	4.1	C, P	⊙
• Adobe Road		0	0	C, P	=

Table 4.9-10

Aquatic Biological Resources Impacts by Component - Storage Reservoirs, Criterion #1

Evaluation Criteria	Point of Significance	Impact[1]		Type of Impact[2]	Level of Significance[3]
• Tolay Confined		2	4.1	C, P	⊙
• Lakeville Hillside		4	1.7	C, P	⊙
• Sears Point		2	2.1	C, P	⊙
• Two Rock		11	8.4	C, P	⊙
• Bloomfield		1	3.6	C, P	⊙
• Carroll Road		0	0	C, P	=
• Valley Ford		2	8.4	C, P	⊙
• Huntley		8	1.2	C, P	⊙

Source: Harland Bartholomew & Associates, Inc., 1996

Notes:

1. See note at end of analysis.
2. Type of Impact:
   - C Construction
   - P Permanent
3. Level of Significance codes:
   - ⊙ Significant impact before mitigation; less than significant impact after mitigation
   - = No impact

Impact: **9.5.1. Will the storage reservoir component cause a loss of individuals or occupied habitat of endangered, threatened, or rare aquatic wildlife or plant species?**

Analysis: *Significant; Alternatives 2, 3A, 3B, 3D, and 3E.*

Tolay Extended, Tolay Confined, Lakeville Hillside, Sears Point, Two Rock, Bloomfield, Valley Ford, and Huntley Reservoirs and associated facilities (including dams, access roads, pump stations, and diversion channels) will result in the loss of at least one California red-legged frog and greater than zero acres of occupied California red-legged frog habitat. Maps B-1 through B-7 of the *Biological Resources, Volume 4B* illustrate the California red-legged frog occurrences identified for each storage

reservoir site (Harland Bartholomew & Associates, Inc. 1996d). Impacts of the Adobe Road site are discussed under No Impact below.

No other endangered, rare, or threatened species or their habitat was found.

No Impact; Alternatives 1, 3C, 4, and 5.

Adobe Road and Carroll Road reservoirs and associated facilities will not result in the loss of individuals or occupied habitat of federally proposed or listed or federal candidate aquatic wildlife or plant species and therefore there is no impact.

Note: There are two closely related subspecies of red-legged frog in the Project area: California and northern. The identity of the species within any one alternative is unclear. Northern red-legged frogs are a California Department of Fish and Game species of special concern. The California red-legged frog is federally-threatened.

The recent federal ruling establishing the final status of California red-legged frog as federally-threatened provided the geographic range of the species. Red-legged frogs in the Walker Creek, Sonoma Creek, Petaluma River, and Tolay Creek watersheds are identified as the California subspecies and are considered federally-threatened (Miller 1996.) All other red-legged frogs in the Project area appear to be the northern subspecies, although final confirmation as not been received.

In the current analysis, all red-legged frogs in the Project area are considered to be the California subspecies though the status will be confirmed prior to the Final EIR/EIS. All red-legged frogs not determined to be the California subspecies will be evaluated as a species of special concern. Findings of significance and proposed mitigation are not expected to change.

No other endangered, rare, or threatened species or their habitat was found.

Alternatives 1, 4, and 5 do not have a storage reservoir component.

Mitigation: *Alternatives 2, 3A, 3B, 3D, and 3E.*

2.3.11. Sensitive Resource Conservation Program

2.4.4. California Red-legged Frog Capture and Relocation Program

Alternatives 1, 3C, 4, and 5. No mitigation is needed.

After
Mitigation: *Less than Significant after Mitigation; Alternatives 2, 3A, 3B, 3D, and 3E.*

California red-legged frog habitat will be created (one acre created to one acre impacted) or restored (two acres restored to one acre impacted) in conjunction with other associated biological resource mitigation (e.g. jurisdictional wetlands, aquatic habitat, and sensitive vegetative communities). Red-legged frogs on site will be captured and relocated to the mitigation site.

Impact: 9.5.2. Will the storage reservoir component cause loss of populations of CNPS List 2, 3, or 4 aquatic plant species?

Table 4.9-11

Aquatic Biological Resources Impacts by Component - Storage Reservoirs
Criterion #2

Evaluation Criteria	Point of Significance	Impact		Type of Impact[1]	Level of Significance[2]
2. Will the storage reservoir component cause loss of individuals of CNPS List 2, 3, or 4 aquatic plant species?	Greater than 15 percent of known occurrences in Sonoma and Marin counties				
Lobb's aquatic buttercup		**Species Occurrences**	**% of known occurrences**		
• Huntley		1	3%	C	O
• All other reservoirs		0	0	C	==

Source: Harland Bartholomew & Associates, Inc., 1996

Notes: 1. Type of Impact:
C Construction

2. Level of Significance codes:
O Less than significant impact; no mitigation proposed
= No impact

Analysis: *Less than Significant; Alternative 3E.*

Construction of the Huntley storage reservoir and associated facilities (including dams, access roads, pump stations, and diversion channels) will result in the loss of one population of Lobb's aquatic buttercup. Map C-7 of the *Biological Resources, Volume 4C* illustrates the Lobb's aquatic buttercup occurrence identified for the Huntley storage reservoir site (Harland Bartholomew & Associates, Inc. 1996e). Lobb's aquatic

buttercup is a CNPS List 4 species with known occurrences in Sonoma and Marin counties. Though CNPS List 4 plants are limited in distribution, a loss of 15 percent or less of the occurrences in the region of the Project will not cause a substantial range contraction, resulting in Lobb's aquatic buttercup becoming threatened with extinction, or substantially diminishing the habitat of Lobb's aquatic buttercup (CEQA Section 15065). The loss of one population represents three percent of the known occurrences of this species and therefore will constitute a less than significant impact.

No Impact; Alternatives 1, 2, 3A, 3B, 3C, 3D, 4 and 5.

Results of special-status plant surveys within the construction zone boundaries of the Tolay Extended, Adobe Road, Tolay Confined, Lakeville Hillside, Sears Point, Two Rock, Bloomfield, Carroll Road, and Valley Ford storage reservoir sites indicate that none of these sites currently support populations of CNPS List 2, 3, or 4 aquatic plant species. Therefore, construction of the storage reservoir will not result in impacts to these species.

Alternatives 1, 4, and 5 do not have a storage reservoir component.

Mitigation: No mitigation is proposed.

Impact: **9.5.3. Will the storage reservoir component cause loss of occupied or potential habitat of aquatic wildlife species of concern?**

Table 4.9-12

Aquatic Biological Resources Impacts by Component - Storage Reservoirs
Criterion #3

Evaluation Criteria	Point of Significance	Impact		Type of Impact[1]	Level of Significance[2]
9.5.3. Will the storage reservoir component cause loss of occupied or potential habitat of aquatic wildlife species of concern?	Greater than 20 percent of habitat in local watershed	a. Linear feet of warm water habitat; b. Acres of pond habitat	% of habitat in local watershed		

Table 4.9-12

Aquatic Biological Resources Impacts by Component - Storage Reservoirs Criterion #3

Evaluation Criteria	Point of Significance	Impact		Type of Impact[1]	Level of Significance[2]
Northwestern pond turtle habitat		**Linear Feet and Acres**	**% of Habitat**		
• Tolay Extended		a. 15,300 lf b. 1.3 acres	29% 100%	C	⊙
• Adobe Road		0.0 acres	0%	C	==
• Tolay Confined		a. 10,600 lf b. 1.3 acres	14% 100%	C	⊙
• Lakeville Hillside		0.0 acres	0%	C	==
• Sears Point		0.0 acres	0%	C	==
• Two Rock		a. 3,000 lf b. 3.9 acres	4% 7%	C	❍
• Bloomfield		a. 5,200 lf b. 0.0 acres	9% 0%	C	❍
• Carroll Road		a. 1,500 lf b. 2.6 acres	6% 9%	C	❍
• Valley Ford		a. 2,000 lf b. 2.0 ac	6% 12%	C	❍
• Huntley		a. 4,000 lf b. 0.5 acres	4% 0%	C	❍

Source: Harland Bartholomew & Associates, Inc., 1996

Notes: 1. Type of Impact:
C Construction

2. Level of Significance codes:
⊙ Significant impact before mitigation; less than significant impact after mitigation
❍ Less than significant impact; no mitigation proposed
== No impact

Analysis: *Significant; Alternatives 2A and 2C.*

Construction of either of the Tolay storage reservoirs will result in the loss of up to 15,300 lf (warmwater) and 1.3 acres (pond) of occupied northwestern pond turtle habitat (*Biological Resources, Volume 4B*, Maps B-3 and B-4, [Harland Bartholomew & Associates, Inc. 1996d]). The northwestern pond turtle is listed as a species of special concern by the California Department of Fish and Game. Although the species of special

concern designation does not warrant any formal protection under the state Endangered Species Act, populations are monitored closely by the California Department of Fish and Game. A loss of 20 percent of potential habitat in the local watershed at any one storage reservoir site will seriously threaten the survival of the turtle populations living there. Reservoir construction and inundation will cause a 29 percent loss of warmwater habitat and 100 percent loss of pond habitat in the local watershed at Tolay Extended or 14 percent loss of warmwater habitat and 100 percent loss of pond habitat at the Tolay Confined site. Therefore this impact is considered significant.

No other species of special concern were identified within the reservoir construction zones.

Less than Significant; Alternative 3.

Construction of Two Rock, Bloomfield, Carroll Road, Valley Ford, and Huntley reservoirs will result in the loss of less than 20 percent of potential habitat in the local watershed of any one of the proposed storage reservoir sites (*Biological Resources, Volume 4B*, Maps B1, B6, and B7 [Harland Bartholomew & Associates, Inc. 1996d]).

No other species of special concern were identified within the reservoir construction zones.

No Impact; Alternatives 1, 2B, 2D, 4, and 5.

Results of special-status aquatic wildlife and plant surveys indicate that there is no occupied habitat of state species of special concern or state fully protected aquatic wildlife species on the Adobe Road, Lakeville Hillside, and Sears Point reservoir sites. Construction of these storage reservoirs will therefore not result in a loss of occupied habitat of state species of special concern or state fully protected aquatic wildlife species nor impact these species.

Alternatives 1, 4, and 5 do not have a storage reservoir component.

Mitigation: *Alternatives 2A and 2C.*

2.3.11. Sensitive Biological Resources Conservation Program

Alternatives 1, 2B, 2D, 3, 4, and 5. No mitigation is proposed.

After Mitigation: *Less than Significant after Mitigation; Alternatives 2A and 2C.*

Western-pond turtle habitat will be created or degraded habitat will be restored. Each linear foot or acre of western pond turtle habitat will be replaced by the restoration or creation of one linear-foot or acre. This mitigation will be conducted in conjunction with mitigation proposed for other biological resources impacts (e.g. aquatic habitat and jurisdictional wetlands).

Table 4.9-13

Aquatic Biological Resources Impacts by Component - Storage Reservoirs Criterion #4

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
9.5.4. Will the storage reservoir component cause loss of sensitive aquatic plant communities?	Greater than 0 acres			
Freshwater marsh				
• Two Rock		0.41 acres	C	⊙
• All Other Reservoirs		0	C	==

Source: Harland Bartholomew & Associates, Inc., 1996

Notes: 1. Type of Impact:
C Construction

2. Level of Significance codes:
⊙ Significant impact before mitigation; less than significant impact after mitigation
== No impact

Impact: **9.5.4. Will the storage reservoir component cause permanent loss of sensitive native aquatic plant communities?**

Analysis: *Significant; Alternative 3A.*

Construction of the Two Rock storage reservoir and associated facilities will result in the loss of approximately 0.4 acres of freshwater marsh (*Biological Resources, Volume 4C*, Map C-1 [Harland Bartholomew & Associates, Inc. 1996e]). This plant community has undergone tremendous reduction in distribution and acreage over the last 100 years and is considered sensitive by the California Department of Fish and Game. Any loss of this plant community will be a significant impact.

No Impact; Alternatives 1, 2, 3B, 3C, 3D, 3E, 4, and 5.

Construction of all other storage reservoir components will not result in the loss of sensitive aquatic plant communities and therefore there is no impact.

Alternatives 1, 4, and 5 do not have a storage reservoir component.

Mitigation: *Alternative 3A.*

2.3.11. Sensitive Biological Resources Conservation Program

Alternatives 1, 2, 3B, 3C, 3D, 3E, 4, and 5. No mitigation is needed.

After Mitigation: *Less than Significant after Mitigation; Alternative 3A.*

Measures of the program will require creation of an equivalent acreage of freshwater marsh or restoration of two times the acreage impacted in conjunction with other biological resources mitigation (e.g. aquatic habitat and jurisdictional wetlands).

Table 4.9-14

Aquatic Biological Resources Impacts by Component - Storage Reservoirs
Criterion #5

Evaluation Criteria	Point of Significance	Impact		Type of Impact[1]	Level of Significance[2]
9.5.5. Will the storage reservoir component cause loss of aquatic habitat?					
a) Coolwater Type A stream habitat	**Greater than 0 linear feet**	**Linear Feet**	**Percent**		
• All reservoirs		0	0%	C, P	==
(b) Coolwater Type B stream habitat	**Greater than 0 linear feet**	**Linear Feet**	**Percent**		
• Carroll Road		2,700	100%	C, P	⊙
• All Other Reservoirs		0	0%	C, P	==
(c) Warmwater Type A stream habitat	**Greater than 15% of habitat in watershed**	**Linear Feet**	**Percent**		

Table 4.9-14

Aquatic Biological Resources Impacts by Component - Storage Reservoirs
Criterion #5

Evaluation Criteria	Point of Significance	Impact		Type of Impact[1]	Level of Significance[2]
• Tolay Extended		1,850	29%	C, P	⊙
• Adobe Road		0	0%	C, P	==
• Tolay Confined		1,850	29%	C, P	⊙
• Lakeville Hillside		0	0%	C, P	==
• Sears Point		5,200	53%	C, P	⊙
• Two Rock		6,000	6%	C, P	○
• Bloomfield		0	0%	C, P	==
• Carroll Road		3,400	6%	C, P	○
• Valley Ford		5,300	9%	C, P	○
• Huntley		4,100	4%	C, P	○
d) Warmwater Type B stream habitat	**Greater than 25% of habitat in watershed**	**Linear Feet**	**Percent**		
• Tolay Extended		27,300	31%	C, P	⊙
• Adobe Road		7,000	18%	C, P	○
• Tolay Confined		12,500	17%	C, P	○
• Lakeville Hillside		10,100	54%	C, P	⊙
• Sears Point		13,100	17%	C, P	○
• Two Rock		7,700	4%	C, P	○
• Bloomfield		14,500	14%	C, P	○
• Carroll Road		6,900	7%	C, P	○
• Valley Ford		4,000	4%	C, P	○
• Huntley		7,000	3%	C, P	○
e) Pond habitat	**Greater than 25% of habitat in watershed**	**Acres**	**Percent**		
• Tolay Extended		1	6%	C, P	○
• Adobe Road		3	67%	C, P	⊙
• Tolay Confined		1	6%	C, P	○
• Lakeville Hillside		1	100%	C, P	⊙
• Sears Point		< 1	3%	C, P	○

Table 4.9-14

Aquatic Biological Resources Impacts by Component - Storage Reservoirs
Criterion #5

Evaluation Criteria	Point of Significance	Impact		Type of Impact[1]	Level of Significance[2]
• Two Rock		6	5%	C, P	❍
• Bloomfield		1	3%	C, P	❍
• Carroll Road		3	10%	C, P	❍
• Valley Ford		2	7%	C, P	❍
• Huntley		1	1%	C, P	❍

Source: Harland Bartholomew & Associates, Inc., 1996

Notes: 1. Type of Impact:
P Permanent
C Construction

2. Level of Significance:
⦿ Significant impact before mitigation; less than significant impact after mitigation
❍ Less than significant impact; no mitigation proposed
= No impact

Impact: **9.5.5. Will the storage reservoir component result in loss of aquatic habitat?**

Analysis: **a) Coolwater Type A Stream Habitat**

No Impact; All Alternatives.

Construction of the reservoirs will not result in the loss of any Coolwater Type A stream habitat.

Alternatives 1, 4, and 5 do not have a storage reservoir component.

b) Coolwater Type B Stream Habitat

Significant; Alternative 3C.

The Carroll Road reservoir will result in the loss of 2,700 linear feet of coolwater B stream habitat. This represents 100 percent of the coolwater B habitat in the watershed.

No Impact; Alternatives 1, 2, 3A, 3B, 3D, 3E, 4, and 5.

Construction of the other reservoirs will not result in the loss of any Coolwater Type B stream habitat.

Alternatives 1, 4, and 5 do not have a storage reservoir component.

c) Warmwater Type A Stream Habitat

Significant; Alternatives 2A, 2C, and 2D.

Tolay Extended, Tolay Confined, and Sears Point storage reservoir component will result in the loss of greater than 15 percent of Warmwater A stream habitat.

Less than Significant; Alternatives 3A, 3C, 3D, and 3E.

The Two Rock, Carroll Road, Valley Ford, and Huntley reservoirs will result in the loss of less than 15 percent of Warmwater Type A stream habitat in each watershed.

No Impact; Alternatives 1, 2B, 2D, 3B, 4, and 5.

The Adobe Road, Lakeville Hillside, and Bloomfield reservoirs will not result in the loss of any Warmwater Type A stream habitat.

Alternatives 1, 4, and 5 do not have a storage reservoir component.

d) Warmwater Type B Stream Habitat

Significant; Alternatives 2A, 2B, and 2D.

The Tolay Extended and Lakeville Hillside Reservoirs and associated facilities will result in the loss of greater than 25 percent of Warmwater Type B stream habitat in each watershed.

Less than Significant; Alternatives 2C and 3.

All other reservoirs will result in the loss of less than 25 percent of Warmwater Type B stream habitat in each watershed.

No Impact; Alternatives 1, 4, and 5.

Alternatives 1, 4, and 5 do not have a storage reservoir component.

e) Pond Habitat

Significant; Alternatives 2B and 2D.

The Adobe Road and Lakeville Hillside Reservoirs and associated facilities will result in the loss of greater than 25 percent of pond habitat in each watershed.

Less than Significant; Alternatives 2A, 2C, and 3.

All other reservoirs will result in the loss of less than 25 percent of Pond habitat in each watershed.

No Impact; Alternatives 1, 4, and 5.

Alternatives 1, 4, and 5 do not have a storage reservoir component.

Maps B-1 through B-7 of the *Biological Resources, Volume 4B* (Harland Bartholomew & Associates, Inc. 1996d) illustrate all of the aquatic habitat types mapped for each storage reservoir site that are described in the aforementioned analysis.

Mitigation: *Alternatives 2 and 3C.*

2.3.11. Sensitive Biological Resources Conservation Program

Alternatives 1, 3A, 3B, 3D, 3E, 4, and 5. No mitigation is proposed.

After Mitigation: *Less than Significant after Mitigation; Alternatives 2 and 3C.*

Implementing the measures of the Sensitive Resource Conservation Program will result in creation of aquatic habitat and habitat function (one acre created to one acre lost) or restoration of habitat and function (two acres restored to one acre lost). Mitigation will be completed in association with other biological resource mitigation (e.g. jurisdictional wetlands, aquatic habitat, and red-legged frog habitat).

Table 4.9-15

Aquatic Biological Resources Impacts by Component - Storage Reservoirs
Criterion #6

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
9.5.6. Will the Project cause a change in the physical condition of aquatic habitat in the Estero Americano or the Estero de San Antonio within the Gulf of the Farallones National Marine Sanctuary?	Greater than 0 ppt salinity change			
• South County Reservoirs		0 ppt	C, P	=
• West County Reservoirs		Greater than 0 ppt	C, P	●

Source: Harland Bartholomew & Associates, Inc., 1996

Notes: 1. Type of Impact:
- P Permanent
- C Construction
- ppt parts per thousand

2. Level of Significance codes:
- ● Significant impact before and after mitigation
- = No impact

Impact: **9.5.6. Will the storage reservoir component cause a change in the physical conditions of aquatic habitat in the Estero Americano or the Estero de San Antonio within the Gulf of the Farallones National Marine Sanctuary?**

Analysis: *Significant; Alternative 3.*

West County reservoirs may affect salinity in the Estero Americano and Estero de San Antonio through subflow entering streams. This will be considered a significant impact.

No Impact; Alternatives 1, 2, 4, and 5.

Alternative 2 storage reservoir components are located in the South County and not located in watersheds that will contribute to the flows of the esteros.

Alternatives 1, 4, and 5 do not have a storage reservoir component.

Mitigation: *Alternative 3.* No feasible mitigation has been identified (see Section 4.6, Surface Water Quality).

Table 4.9-16

Aquatic Biological Resources Impacts by Component - Storage Reservoirs, Criterion #7

Evaluation Criteria	Point of Significance	Impact (corridors)	Type of Impact[1]	Level of Significance[2]
9.5.7. Will the storage reservoir component substantially block or disrupt major fish or aquatic wildlife migration or travel corridors?	Greater than 0 corridors		C, P	=
• Alternative 3C		None	C	○
• All others		None		=

Source: Harland Bartholomew & Associates, Inc., 1996

Notes: 1. Type of Impact:
P Permanent
C Construction

2. Level of Significance codes:
= No impact
○ Less than significant impact; no mitigation proposed

Impact: **9.5.7. Will the storage reservoir component substantially block or disrupt major fish or aquatic wildlife migration or travel corridors?**

Analysis: *Less than Significant; Alternative 3C.*

During aquatic habitat assessments, one individual steelhead trout was found in the Carroll Road storage reservoir site. Though presence of an individual of a migratory presence of an individual of a migratory species may indicate a migration corridor in the vicinity, no other evidence of migration was present. There are no known corridors or breeding sites known in this tributary. The origin of this specimen is unknown. If a migration corridor is present in this stream system, it is not a major corridor. Therefore, this impact is considered less than significant.

No Impact; Alternatives 1, 2, 3A, 3B, 3D, 3E, 4, and 5.

All other reservoir sites will not be expected to act as barriers to the movement of migratory fish, because migratory fish species are not known to use any of those stream systems. There will be no impacts.

Alternatives 1, 4, and 5 do not have a storage reservoir component.

Mitigation: No mitigation is needed.
Alternatives 1, 2, 3A, 3B, 3D, 3E, 4, and 5. No mitigation is needed.

Table 4.9-17

Aquatic Biological Resources Impacts by Component - Storage Reservoirs
Criterion #8

Evaluation Criteria	Point of Significance	Impact (percent)	Impact (linear feet)	Type of Impact	Level of Significance
9.5.8. Will the storage reservoir component cause a decrease in streamflows, affecting aquatic habitat or aquatic life downstream from dam structures?	Greater than 0 linear feet of warmwater stream habitat where 50 percent decrease in wet season streamflow or any decrease in dry season streamflow occurs.				
• Tolay Extended		53% decrease in wet season flows	38,150 lf (18,150 lf of warmwater A and 20,000 lf of warmwater B habitat)	C, P	⊙
• Adobe Road		less than 50% decrease in wet season flows	0 lf	C, P	○
• Tolay Confined		53% decrease in wet season flows;	38,150 lf (18,150 lf of warmwater A and 20,000 lf of warmwater B habitat)	C, P	⊙
• Lakeville Hillside		60-69% decrease in wet season flows	5,600 lf (all warmwater B habitat)	C, P	⊙

Table 4.9-17

Aquatic Biological Resources Impacts by Component - Storage Reservoirs
Criterion #8

Evaluation Criteria	Point of Significance	Impact (percent)	Impact (linear feet)	Type of Impact	Level of Significance
• Sears Point		less than 50% decrease in wet season flows	0	C, P	○
• Two Rock		less than 50% decrease in wet season flows	0	C, P	○
• Bloomfield		67% decrease in wet season flows	4,900 lf (all warmwater A habitat)	C, P	⊙
• Carroll Road		65% decrease in wet season flows	6,800 lf (2,250 lf of warmwater A and 4,550 lf of warmwater B habitat)	C, P	⊙
• Valley Ford		81% decrease in wet season flows	3,600 lf (all warmwater A habitat)	C, P	⊙
• Huntley		less than 50% decrease in wet season flows	0	C, P	○

Source: Harland Bartholomew & Associates, Inc., 1996

Notes:
1. Type of Impact:
C Construction
P Permanent

2. Level of Significance:
= No impact
○ Less than significant impact
⊙ Significant impact before mitigation; less than significant impact after mitigation

Impact: **9.5.8. Will the storage reservoirs component cause a change in streamflows, affecting aquatic habitat or aquatic life downstream from proposed dam sites?**

Analysis: *Significant; Alternatives 2, 3B, 3C, and 3D.*

Storage reservoirs will intercept streamflow during the wet season, such that flow immediately downstream from the dam may be greatly reduced or eliminated. Four storage reservoirs have diversion structures designed for the 10 year storm level which will divert natural streamflow into the drainage downstream of the dam: Tolay Confined, Tolay Extended, Adobe Road, and Sears Point.

Dams for the Tolay Extended, Tolay Confined, and Lakeville Hillside, Bloomfield, Carroll Road, and Valley Ford reservoirs will intercept all flow coming from upstream except flows redirected through diversion channels (see Chapter 3.3 Description of Existing System and Alternatives). Dams will block downstream flows of the existing waterways within the reservoir footprints and cause a decrease of greater than 50 percent in wet season flow in stream habitat downstream of the proposed dam sites. . See *Aquatic Biological Resource Impact Assessment* for more detailed analysis (Merritt Smith Consulting 1996e).

Less than Significant; Alternatives 3A and 3E.

The Sears Point, Two Rock, Adobe Road, and Huntley reservoirs will not cause a significant reduction in streamflow downstream from these potential dam sites and therefore will not significantly impact stream flows at these locations. See detail of analysis in *Aquatic Biological Resources Impact Analysis Report* (Merritt Smith Consulting 1996e).

No Impact; Alternatives 1, 4, and 5.

Alternatives 1, 4, and 5 do not have a storage reservoir component.

Mitigation: *Alternatives 2, 3B, 3C, and 3D.*

2.3.11. Sensitive Biological Resource Conservation Program

Alternatives 1, 3A, 3E, 4, and 5. No mitigation is proposed.

After Mitigation: *Less than Significant after Mitigation; Alternatives 2, 3B, 3C, and 3D.*

Elements of this measure will compensate for loss of habitat acreage and function through restoration and preservation of existing degraded habitat with similar functions. Due to the limited opportunity to replace or restore hydrology on-site, existing degraded stream systems will be restored to original functions through fencing and revegetation. Restoration of warmwater B habitat to warmwater A habitat will occur as compensation

for both losses to warmwater A and warmwater B habitat, on-site or as an element of a larger ecosystem-based restoration plan. Two linear feet of warmwater B will be restored and preserved for each linear foot of warmwater A affected. One linear foot of warmwater B will be restored and preserved for each linear foot of warmwater B affected.

Table 4.9-18

Aquatic Biological Resources Impacts by Component - Storage Reservoirs Criterion #9

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
9.5.9. Will the storage reservoir component result in ecological risk to aquatic plant and wildlife populations (i.e., acute or chronic toxicity and bioaccumulation)?	EQ greater than 10	EQ range between 0.00 and 3.27	O&M	O

Source: Harland Bartholomew & Associates, 1996

Notes: 1. Type of Impact: O&M Operation and Maintenance
2. Level of Significance: O Less than significant impact; no mitigation proposed

Impact: **9.5.9. Will the storage reservoir component result in ecological risk to aquatic plant and wildlife populations (i.e., acute or chronic toxicity and bioaccumulation)?**

Analysis: *Less than Significant; Alternatives 2 and 3.*

This evaluation of toxicity and bioaccumulation potential of reclaimed waters in the storage reservoirs is provided because aquatic plants and wildlife will be attracted to and become resident in the storage reservoirs when they have water in them.

Based on the ecological quotient calculations, no potential significant risk was identified for direct exposure of aquatic organisms to organic chemicals and metals found at detectable levels in the effluent or the cumulative exposure to sediment. All EQ values were below the significance threshold of 10 (i.e., water is less than 3.27 and sediment is less than 2.28) and so the impacts are considered to be less than

significant. In addition, bioaccumulation of metals in the diet, as measured in the mallard, were well below significance levels (EQ < 0.14). See the *Ecological Risk Assessment* for more detailed analysis (Parsons Engineering Science, Inc. 1996).

No Impact; Alternatives 1, 4, and 5.

Alternatives 1, 4, and 5 do not have a storage reservoir component.

Mitigation: No mitigation is proposed.

Pump Station Component

Impact: 9.6.1-9. Will the pump station component impact aquatic biological resources based on evaluation criteria 1 through 9.

Analysis: *No Impact; All Alternatives*

Pump stations will not impact aquatic plants or wildlife because they are sited away from water or any sensitive aquatic biological resources and because pump stations will not result in aquatic plants or wildlife exposure to reclaimed water.

Measure 2.2.5, adopted as part of the Project, provides that, after appropriate surveys, pump stations be sited at least 30 feet from sensitive plant species and 100 feet away from all other sensitive biological resources (i.e., wetlands, and streams).

Alternatives 1 and 5 do not have a pump station component.

Mitigation: No additional mitigation is proposed.

Agricultural Irrigation Component

Table 4.9-19

Aquatic Biological Resources Impacts by Component - Agricultural Irrigation

Evaluation Criteria	Point of Significance	Impact	Type of Impact	Level of Significance
9.7.1. Will the agricultural irrigation component cause loss of individuals or occupied endangered threatened or rare aquatic wildlife or plant species?	a) Greater than 0 species and b) Greater than 0 acres	None None	C, O&M, O&M-CP C, O&M, O&M-CP	== ==
9.7.2. Will the agricultural irrigation component cause loss of individuals of CNPS List 2, 3, or 4 aquatic plant species?	Greater than 15 percent of presumed extant occurrences or populations in Sonoma and Marin counties	None	C, O&M, O&M-CP	==
9.7.3. Will the agricultural irrigation component cause loss of potential or occupied habitat of aquatic species of concern?	Greater than 20 percent of mapped occupied habitat in all Project components	None	C, O&M, O&M-CP	==
9.7.4. Will the agricultural irrigation component cause a permanent loss of sensitive native aquatic plant communities and associated wildlife habitats.	Greater than 0 acres	None	C, O&M, O&M-CP	==
9.7.5. Will the agricultural irrigation component cause permanent loss of aquatic habitat?	Greater than 15% of Warmwater Type A in local watershed, or Greater than 25% of Warmwater Type B in local watershed.	None	C, O&M, O&M-CP	==

Table 4.9-19

Aquatic Biological Resources Impacts by Component - Agricultural Irrigation

Evaluation Criteria	Point of Significance	Impact	Type of Impact	Level of Significance
9.7.6. Will the agricultural irrigation component cause a change to the physical condition of aquatic habitat in the Estero Americano or the Estero de San Antonio within the Gulf of the Farallones National Marine Sanctuary?	Greater than 0 ppt salinity change			
• West County irrigation areas		Greater than 0	C, O&M, O&M-CP	●
• South County irrigation areas		None	C, O&M, O&M-CP	==
9.7.7. Will the agricultural irrigation component substantially block or disrupt major fish or aquatic wildlife migration or travel corridors?	Greater than 0 corridors	None	C, O&M, O&M-CP	==
9.7.8. Will the agricultural irrigation component cause a decrease in streamflows, affecting aquatic habitat or aquatic life downstream from proposed dam sites?	Greater than 0 linear feet of affected stream habitat	None	C, O&M, O&M-CP	==
9.7.9. Will the agricultural irrigation component result in ecological risk to aquatic plant and wildlife populations (i.e., acute or chronic toxicity and bioaccumulation)?	EQ >10	EQ values range from 0.0 to 6.90	C, O&M, O&M-CP	○

Source: Harland Bartholomew & Associates, Inc., 1996

Notes:

1. Type of Impact:
   - C — Construction
   - O&M — Operation and Maintenance
   - O&M-CP — Operation and Maintenance - Contingency Plan
2. Level of Significance:
   - == No impact
   - ○ Less than significant impact; no mitigation proposed
   - ● Significant impact before and after mitigation

Impact: 9.7.1-5, 7, 8. Will the agricultural irrigation component impact aquatic biological resources based on evaluation criteria 1, 2, 3, 4, 5, 7, and 8.

Analysis: *No Impact; All Alternatives.*

Results of habitat assessments for special-status plant and wildlife species within proposed agricultural irrigation areas indicate that some of the agricultural irrigation areas support special-status aquatic wildlife or plant species (see Table 4.9-1 for a list of these species). Several special-status species, including California red-legged frog, northwestern pond turtle, and Sebastopol meadowfoam, were observed within proposed agricultural irrigation areas. In addition, CNDDB record searches identified the following species within proposed agricultural irrigation areas: Sonoma alopecurus, Sebastopol meadowfoam, Swamp harebell, California freshwater shrimp, foothill yellow-legged frog, California tiger salamander, and northwestern pond turtle. More specific information about these occurrences is provided in *Biological Resources, Volume I, and Volume 4D* (Harland Bartholomew & Associates, Inc. 1996a,f). However, a determination of the presence of special-status species cannot be made in the absence of species-specific surveys. In addition, over the life of a reclamation Project, additional species may receive protective status that do not currently have special-status, but occupy theses lands. Therefore, there is potential for special-status species to occur on agricultural sites when they receive irrigation waters. Implementation of Project description measures will ensure that all impacts to special-status species are avoided.

The City has adopted Project measures (Measure 2.2.2 and Measure 2.2.5) that will require a resource map for every potential irrigation parcel, ensure that biological surveys are verified, and protect sensitive areas within agricultural irrigation areas by establishing buffers for all sensitive biological resources located on all parcels brought into agricultural production with Project reclaimed water. Exclusionary buffers will be established around any identified sensitive plant species habitat, the riparian corridor of all linear waterways and occupied burrows of sensitive ground-dwelling species (including California tiger salamander). Therefore, agricultural irrigation will not result in the loss of individuals or populations or occupied habitat. Table 4.9-20 presents the sensitive native aquatic plant communities in agricultural irrigation areas. Table 4.9-21 presents the aquatic habitat in the proposed agricultural areas. See *Aquatic Habitat Survey Results* (Harland Bartholomew & Associates, Inc. 1996d) for mapping of aquatic habitat in agricultural areas. Therefore, there will be no impact to aquatic special status species, sensitive plant communities, or aquatic habitat.

Results of literature review and discussions with agency experts indicate that no major migration corridors or travel corridors are located within the proposed agricultural irrigation areas. Therefore, there is no impact to migration corridors.

The same procedures to insure avoidance of impacts to endangered, threatened, or rare species will be implemented in the case of agricultural irrigation areas needed for winter irrigation, if the contingency plan is implemented. Therefore, no impacts will occur from winter irrigation.

Alternatives 1, 4, and 5 do not have an agricultural irrigation component.

Table 4.9-20

Sensitive Aquatic Plant Communities in Agricultural Irrigation Areas to Be Avoided

Agricultural Irrigation Area	Brackish Marsh (acres)	Freshwater Marsh (acres)	Vernal Pools (acres)
Sebastopol	0	0.6	0
South County			
Adobe Road	0	0	0
Bay Lands	0	0	20.4
East of Rohnert Park	0	0	5.8
Lakeville	0	0	0.8
North Petaluma Valley	0	0	0.8
West County			
Americano	3.2	0	2.7
Miscellaneous	0	0	0
Stemple	0	0	1.0

Source: Harland Bartholomew & Associates, Inc., 1996

Since this component does not include mechanisms which will block or dam streams, agricultural irrigation will not cause a decrease in streamflows. Therefore, there are no impacts to stream flows.

Mitigation: No additional mitigation is proposed.

Impact: 9.7.6. Will the agricultural irrigation component cause a change to the physical condition of aquatic habitat in the Estero Americano or the Estero de San Antonio within the Gulf of the Farallones National Marine Sanctuary?

Analysis: *Significant; Alternative 3.*

Under various water quality models, small sub-surface wastewater flows from irrigation field leaching may discharge to reaches of the esteros, resulting in small alterations in the salinity distribution in certain reaches. See *Aquatic Biological Resources Impact Analysis Report* for more detailed analysis (Merritt Smith Consulting 1996e).

Table 4.9-21

Aquatic Habitat in Agricultural Irrigation Areas

Agricultural Irrigation Area	**Coolwater A (linear feet)**	**Coolwater B (linear feet)**	**Warmwater A (linear feet)**	**Warmwater B (linear feet)**	**Ponds (Acres)**
Sebastopol	0	25,100	9,300	5,300	10.5
South County					
Adobe Road	0	0	600	20,000	2.0
Bay Lands	0	0	0	16,300	2.5
East of Rohnert Park	0	5,000	0	68,000	8.0
Lakeville	0	0	0	40,800	23.5
North Petaluma Valley	0	0	12,500	3,400	0.5
West County					
Americano	0	0	61,800	23,500	26.0
Miscellaneous	0	0	0	8,300	7.5
Stemple	0	2,900	68,000	50,600	71.0

Source: Harland Bartholomew & Associates, Inc., 1996

Winter irrigation may occur in all irrigation areas as needed. Normal summer irrigation will lead to a salinity change in the esteros and was determined to be a significant impact. Due to its infrequency and limited duration of application, winter irrigation is expected to create a lesser alteration to the salinity in the esteros than dry season irrigation. However, significance of the impact is defined by any change and therefore winter irrigation impacts the esteros significantly.

No Impact; Alternatives 1, 2, 4, and 5.

Alternative 2 agricultural irrigation areas do not drain into the esteros or their watersheds.

Alternatives 1, 4, and 5 do not have an agricultural irrigation component.

Mitigation: *Alternative 3.* No feasible mitigation has been identified.

Alternatives 1, 2, 4, and 5. No mitigation is needed.

Impact: **9.7.9. Will the agricultural irrigation component result in ecological risk to aquatic plant and wildlife populations (i.e., acute or chronic toxicity and bioaccumulation)?**

Analysis: *Less than Significant; Alternatives 2 and 3.*

This evaluation of toxicity and bioaccumulation potential of reclaimed water irrigation is provided because aquatic plants and wildlife may be attracted to or become resident in the irrigation areas because of the runoff catch basins below some irrigated fields and because subsurface flows from the irrigated fields may enter downgradient water bodies. Ecological quotients (EQ) were calculated for exposure to undiluted reclaimed water applied directly to agricultural irrigation fields and for the exposure of freshwater and marine organisms to agricultural runoff (including the esteros). The EQ for risk to freshwater organisms from chronic exposure to dissolved metals and pesticides in irrigated percolate water range from 0.00 to 1.08 and a cumulative EQ of 0.0 to 3.88 and the EQ for risk to aquatic organisms in the esteros from chronic exposure to dissolved metals and pesticides in irrigated percolate water range from 0.00 to 4.24 with the cumulative EQ of 0.0 to 6.9. All EQ values are below the significance threshold of 10 and therefore the impact is less than significant.

During dry winters, discharge to the Russian River may be restricted by low Russian River flows. During these periodic events, wastewater will be provided to farmers outside the normal irrigation season. Water will only be provided to areas under evaluation as summer irrigation areas.

Irrigation runoff and ponding may occur due to faulty operation or pipeline leakage. Measures adopted as part of the Project have been developed to avoid runoff and ponding. These measures include 2.2.2, Irrigation Site Resource Maps, and 2.2.5, Avoid Sensitive Biological Resources which have been designed to avoid the potential effects of runoff and ponding by providing for identification and buffering of special-status aquatic plant and wildlife species and occupied habitats. In addition, there are no direct physical effects to aquatic plant or wildlife species or permanent changes to aquatic habitat due to changes in hydrology because the effects of runoff or pipeline leakage are temporary. For indirect effects to aquatic vegetation and organisms due to release of reclaimed water refer to *Ecological Risk Assessment* (Parsons Engineering Science, Inc. 1996). Therefore, any potential impacts to the designated species and occupied habitats from irrigation pipeline rupture will be less than significant.

No Impact; Alternative 1, 4, and 5.

Alternatives 1, 4, and 5 do not have an agricultural irrigation component.

Mitigation: No additional mitigation is proposed.

Geysers Steamfield Component

The following impact analysis addresses potential impacts associated with the proposed construction of two storage holding tanks, in-field pipes and access roads and the application of reclaimed water into the geysers steamfield via existing injection wells. No component table is presented for the geysers component since there are no impacts for any criterion. This component includes pipelines within the steamfield.

Impact: **9.8.1-9. Will the geysers steamfield component impact aquatic biological resources based on evaluation criteria 1 through 9.**

Analysis: *No Impact; All Alternatives.*

No special-status aquatic species or aquatic habitat are potentially present within or adjacent to proposed tank locations and existing injection well sites. The construction associated with the storage tanks will occur on a ridge top which is not located near any aquatic habitats. Construction of the in-field pipeline may result in loss of potential or occupied habitat of aquatic species of concern.

However, Measure 2.2.5 serves to avoid environmentally sensitive areas along pipelines, pump stations, and electrical systems and establishes procedures for avoidance of construction impacts to special-status aquatic wildlife or plant species and habitats.

Because exclusionary buffers for sensitive biological resources will be incorporated in the final Project design, the potential loss of individuals or occupied habitat of aquatic wildlife or plant species will be avoided.

Alternatives 1, 2, 3, and 5 do not have a geyser steamfield component.

Mitigation: No additional mitigation is proposed.

Discharge Component

Table 4.9-22

Aquatic Biological Resources Impacts by Component - Discharge

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
9.9.1. Will the discharge component cause loss of individuals or occupied habitat of endangered, threatened, or rare candidate aquatic wildlife or plant species?	a) Greater than 0 species b) Greater than 0 acres	None	P	==
9.9.2. Will the discharge component cause loss of individuals of CNPS List 2, 3, or 4 aquatic plant species?	Greater than 15 percent of presumed extant occurrences or populations in Sonoma and Marin counties	None	P	==
9.9.3. Will the discharge component cause loss of potential or occupied habitat of aquatic species of concern?	Greater than 20 percent of mapped occupied habitat in all project components	None	P	==
9.9.4. Will the discharge component cause a permanent loss of sensitive native aquatic plant communities?	Greater than 0 Acres	None	P	==
9.9.5. Will the discharge component cause a permanent loss of aquatic habitat?	Greater than 0 linear feet	None	P	==
9.9.6. Will the discharge component cause a change to the physical condition of habitat or aquatic life in the Estero Americano or the Estero de San Antonio within the Gulf of the Farallones National Marine Sanctuary?	Greater than 0 ppt salinity change	None	P	==

Table 4.9-22

Aquatic Biological Resources Impacts by Component - Discharge

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
9.9.7. Will the discharge component substantially block or disrupt major fish or aquatic wildlife migration or travel corridors?	Greater than 0 corridors	None	P	❍
9.9.8. Will the discharge component cause a decrease in streamflows, affecting aquatic habitat or aquatic life downstream from proposed dam sites?	Greater than 0 linear feet of affected stream habitat	None	--	==
9.9.9. Will the discharge component result in ecological risk to aquatic plant and wildlife populations (i.e., acute or chronic toxicity and bioaccumulation)?	EQ Greater than 10	EQ values range from 0.0 to 9.28	O&M, O&M-CP	❍

Source: Harland Bartholomew & Associates, Inc., 1996

Notes:
1. Type of Impact:
P — Permanent
O&M — Operation and Maintenance
O&M-CP — Operation and Maintenance - Contingency Plan

2. Level of Significance:
== No impact
❍ Less than significant impact; no mitigation proposed

Impact: 9.9.1-6, and 8. Will the discharge component impact aquatic biological resources based on evaluation criteria 1 through 6, and 8?

Analysis: *No Impact; All Alternatives.*

Project Measure 2.2.5 serves to avoid environmentally sensitive areas along pipelines, pump stations, and electrical systems and establishes procedures for avoidance of construction impacts to sensitive aquatic wildlife or plant species and habitats.

Construction of a Russian River outfall will be restricted to the low flow period when the water level is below the construction area. Therefore, potential loss of individuals or occupied habitat of aquatic wildlife or plant species will be avoided.

Mitigation: No additional mitigation is proposed.

Impact: 9.9.7. Will the discharge component substantially block or disrupt major fish or aquatic wildlife migration or travel corridors?

Analysis: *Less than Significant; All Alternatives.*

The Russian River and Laguna de Santa Rosa have been the subject of numerous studies in recent years, sponsored by California Department of Fish and Game, Sonoma County Water Agency, and the Subregional System.

A five-year study of the effects of reclaimed water discharge on steelhead trout and coho salmon migration and production in the Laguna de Santa Rosa watershed is summarized in Merritt Smith Consulting (1995, 1996f). This study involved the evaluation of the number of adults migrating upstream to spawn, the number of juvenile produced, habitat factors affecting juvenile production, and the number of adults and juveniles returning to the sea. The number of captured migrating fish was compared to the concentration of reclaimed water in the migration corridor as one means of evaluating for potential reclaimed water impacts. Juvenile production was also evaluated relative to reclaimed water discharge.

A general conclusion of these studies is that the mainstem of the river is warmwater Type A habitat for at least five months of each year. During the winter, the river serves as a migration corridor for anadromous fishes (i.e., steelhead trout and coho salmon) moving to or from the Laguna drainage and other spawning and juvenile resting areas. The overall conclusion of the Russian River and Laguna studies summarized in the above-referenced document is that the discharge of reclaimed water into the migration corridor in Santa Rosa and Mark West creeks does not constitute impairment of these streams with respect to migration, reproduction, or rearing of anadromous fish. Therefore, this impact is less than significant.

Mitigation: No mitigation is proposed.

Impact: 9.9.9. Will the discharge component result in ecological risk to aquatic plant and wildlife populations (i.e., acute or chronic toxicity and bioaccumulation)?

Analysis: *Less than Significant; All Alternatives.*

Potential ecological risks were evaluated for a 20 percent design discharge to the River. The maximum contribution of reclaimed water to the

Russian River flow is likely to occur only during very dry-weather conditions. Under typical flow conditions, reclaimed water concentrations in the Russian River will be considerably smaller than those indicated by the design discharge values.

In the Laguna de Santa Rosa, reclaimed water contributions vary considerably depending on the reach of the Laguna. At the discharge point at Delta Pond on Santa Rosa Creek, the contribution will be the highest. For the purposes of the ecological risk assessment the contribution of reclaimed water in the Laguna has been chosen as the median value of an average rainfall year near the Delta Pond discharge -- 35 percent (35 percent of the Laguna is reclaimed water).

Three transfer pathways were considered for the potential exposure of Russian River and Laguna de Santa Rosa organisms to effluent constituents: direct exposure of aquatic organisms, water ingestion from the stream by wildlife species; and exposure by fish consumption by piscivorous birds and mammals. In addition, risk assessment was analyzed for chronic exposure of endangered, threatened, or other special-status aquatic species to the treated effluent. Results of cumulative ecological quotient calculations for 20 percent design discharge into the Russian River (directly to the Russian River or via the Laguna de Santa Rosa) indicate that the direct exposure of aquatic organisms ($0.00 \leq EQ \leq 2.82$), aquatic life exposure by fish ingestion ($0.00 \leq EQ \leq 9.28$), aquatic life exposure by water intake ($0.00 \leq EQ \leq 0.02$), and risk to freshwater endangered species ($0.00 \leq EQ \leq 0.17$), are less than significant. Impacts to aquatic organisms in the Laguna are assessed at 100 percent effluent exposure. EQs for the Laguna are less than 8.4. All ecological quotient values for discharge less than the threshold value of 10 and so the impacts are less than significant. See the *Ecological Risk Assessment* for more detailed analysis (Parsons Engineering Science, Inc. 1996). Impacts of lower levels of discharge for other alternatives will be less.

During dry winters, discharge to the Russian River may be restricted by low Russian River flows. During these periodic events, contributions of reclaimed water to the Russian River or Laguna will increase substantially. However, these discharges will last for very short periods, a maximum of four days. Because of such a brief exposure, it is not appropriate to apply the same chronic risk factors as for the previous risk assessment. No bioaccumulation will occur during such short exposures. Impacts will be the same as non-contingency discharge.

No Impact; Alternatives 1 and 4.

Alternatives 1 and 4 do not have a contingency plan for discharge.

Mitigation: No mitigation is proposed.

CUMULATIVE IMPACTS

There are eight impacts -- either less than significant or significant -- identified in the Aquatic Biological Resources section:

Impact: **9.1C. Will the Project plus cumulative projects cause loss of individuals or occupied endangered, threatened, or rare wildlife plant species?**

Analysis: The Project impacts are to alternatives 2, 3A, 3B, 3D, and 3E.

Construction of storage sites will result in the loss of 1.4 to 8.7 acres of California red-legged frog habitat (except Carroll Road and Adobe Road). All losses are considered significant and will be fully mitigated through habitat creation, restoration and preservation and red-legged frog translocation. All frogs were found in marginal habitats. Mitigation will not only fully compensate for the losses, but will provide long-term preservation of their habitats.

The cumulative projects list (Appendix D-31) identifies 504 projects which are undergoing some level of review by the U.S. Corps of Engineers for wetlands fill in the cumulative project area. Many of these projects may impact red-legged frog habitat. The protection of the California red-legged frog habitat potentially affected by these projects is guaranteed through the Endangered Species Act which requires federal agencies insure that their actions (including permitting) are not likely to jeopardize the continued existence of listed species. Therefore, mitigated impacts to red-legged frogs should be minimal.

Since the impacts of the Project will be fully mitigated as well as the cumulative projects, no additional cumulative effect is identified for this impact. No additional mitigation is proposed.

Impact: **9.2C. Will the Project plus cumulative projects cause loss of individuals of CNPS List 2, 3, or 4 aquatic plants species?**

Analysis: The Project impacts are to alternative 3E.

The loss of one population of Lobb's aquatic buttercup at the Huntley storage site represents 3 percent of the known populations in Sonoma and Marin counties. This is less than the 15 percent point of significance and therefore is considered less than significant.

Loss of four additional populations from cumulative projects will result in a significant effect. Though it is unknown if the implementation of the

projects identified on the cumulative project list will result in the loss of four additional populations of Lobb's aquatic buttercup, it is probable. Lobb's aquatic buttercup is associated with vernal pools and valley foothill grasslands. Valley foothill grasslands are a common habitat in the region and the site of many projects on the cumulative project lists. Therefore cumulative projects are considered to have a significant effect on Lobb's aquatic buttercup.

Mitigation: 2.4.15. Sensitive Plant Relocation Program. Seeds from the Lobb's aquatic buttercup population will be collected and reestablished in mitigation sites developed as a result of the Sensitive Resource Conservation Plan.

Impact: 9.3C. Will the Project plus cumulative projects cause loss of potential occupied habitat of aquatic species of concern?

Analysis: The Project impacts are to alternatives 2A, 2C, and 3.

Loss of western pond turtle habitat exceeds 20 percent of the potential habitat present in the local watershed at Tolay Extended, and Tolay Confined and is therefore a significant Project impact. Loss of western pond turtle habitat ranges from 4-14 percent on the remaining storage sites (except Adobe Road, Lakeville Hillside, and Sear Point), and is a less than significant impact. The significant impacts at the Tolay storage sites will be fully mitigated through western pond turtle habitat creation, restoration, and preservation in conjunction with other elements of the Sensitive Resource Conservation Program. All pond turtle habitat is also identified as Corps jurisdictional wetlands. Under criteria developed in the Jurisdictional Wetlands Section, all jurisdictional wetlands impacts will be mitigated to result in no net loss of function or acreage. Therefore there will be no net loss of western pond turtle habitat function and acreage associated with the Project.

Though projects in the cumulative projects lists may affect western pond turtles, there will be no net effect from the Project. Therefore no cumulative effects to western pond turtles will occur. No change in the finding of significance or mitigation is proposed.

Impact: 9.4C. Will the Project plus cumulative projects cause loss of potential occupied habitat of aquatic species of concern?

Analysis: The Project impacts are to alternative 3A.

Loss of any sensitive plant community is considered significant for this analysis. The loss of 0.41 acres of freshwater marsh at Two Rock storage

site is therefore a significant impact. This impact will be fully mitigated through the creation, restoration and preservation of 0.41-1.23 acres of freshwater marsh, resulting in no net loss of community acreage or function.

Freshwater marsh is a jurisdictional wetland and therefore is a resource regulated by the Corps. In keeping with the no net loss of wetlands policy set by the executive branch of the federal government, the Corps will require mitigation for freshwater marsh losses associated with any project identified as undergoing Corps review on the cumulative project lost.

Effects of projects in the cumulative project lists on freshwater marsh will be minimal and all impacts associated with the Project are mitigated. Therefore there are no additional cumulative effects. No change in the findings of significance or mitigation is proposed.

Impact: 9.5C. Will the Project plus cumulative projects cause permanent loss of aquatic habitat?

Analysis: The Project impacts are to alternatives 2 and 3.

All south county (Alternative 2) and Carroll Road (Alternative 3C) storage sites will result in significant loss of aquatic habitat (greater than 25 percent loss of the habitat type in the local watershed). All other storage sites will result in less than significant loss of aquatic habitat. The portions of these habitats identified as waters of the U.S. will be mitigated as jurisdictional wetlands (see Jurisdictional Wetlands Resources Section) on all reservoir sites irrespective of the findings of significance in this section. Impacts to aquatic habitat significantly affected will be completely mitigated through creation of new or restoration of existing habitats proximal to the impact area resulting in no net loss of acreage or function.

Many of the projects included in the cumulative project list will impact aquatic habitat but none will affect the local watersheds associated with the storage sites of the Project. In addition, all cumulative projects affecting waters of the U.S. will be subject to Corps review and should be required to mitigate as an element of the federal no net loss policy. All aquatic habitat in streams will, in addition, require California Department of Fish and Game review and issuance of a Section 1601-1603 Streambed Alteration Agreement. Therefore, though there will be small losses of aquatic habitat associated with the Project after mitigation, they are restricted to local watersheds and are not additive to cumulative projects.

Impact: **9.6C. Will the Project plus cumulative projects cause a change to the physical condition of aquatic habitat on the Estero de San Antonio within the Gulf of the Farallones National Marine Sanctuary?**

Analysis: The Project impacts are to alternative 3.

Operation of the west county storage facilities and irrigation system will result in additional freshwater flows to the esteros resulting in an alteration to the salinity in the Gulf of the Farallones National Marine Sanctuary. This impact is unavoidable and no feasible mitigation has been identified.

The cumulative project list includes many projects in the watershed of Stemple and Americano creeks. Even though these projects are limited in size, they have the potential to contribute pollutants to the creeks, and thence to the esteros. Some of these pollutants may overlap with the impacts of the Project, and total impacts to the esteros will be greater than those for the Project alone. Impacts for the project have already been determined to be significant and mitigation has been found to be infeasible. Mitigation for cumulative impacts will also be infeasible.

Impact: **9.8C. Will the Project plus cumulative projects cause a decrease in stream flows, affecting aquatic habitat or aquatic life downstream from proposed dam sites?**

Analysis: The Project impacts are to alternatives 2 and 3.

The impoundment of stream flows associated with the drainages in each storage site watershed of the Project will diminish stream flows seasonally downstream of the dam sites. Dams of the Tolay Extended, Tolay Confined, Lakeville Hillside, Bloomfield, Carroll Road, and Valley Ford storage sites will block at least 50 percent of the flow during the wet season resulting in significant impacts. Dam at Sears Point, Two Rock, Adobe Road, and Huntley storage sites will not significantly block flows (less than 50 percent in the wet season). Significant impact will be mitigated through restoration of existing stream habitat.

The cumulative project list contains four new storage sites (see above analysis). Of these potential storage sites only the City of Petaluma Wastewater facilities projects are placed close enough to the Project storage facilities to have a cumulative effect. Storage sites identified in the City of Petaluma Wastewater facilities projects Revised Draft EIR are in neighboring watersheds to the Tolay, Adobe Road, and Lakeville Hillside storage sites (Alternative 2). Both potential sites of the Petaluma reservoir will diminish stream flows downstream of the dam sites at Higgins and Wheat Creeks. These creeks are not confluent with either the

creek below the Adobe Road storage site, Tolay Creek, or the small ephemeral creek flowing through the Lakeville Hillside storage site. Because of this, no cumulative impacts to stream flow from storage sites are expected. No change in the level of significance or mitigation is proposed.

Impact: **9.9C. Will the Project plus cumulative projects results in ecological risk to aquatic plant and wildlife populations (i.e., acute or chronic toxicity and bioaccumulation)?**

Analysis: The Project impacts are to alternatives 2, 3, and 5.

Exposure at Storage Sites and Agricultural Irrigation Systems. There are less than significant impacts (EQ less than or equal to 10) associated with the operation of storage site and irrigation system (EQ ranging from 0.01 to 5.8).

Several cumulative projects are located near the storage reservoirs or agricultural irrigation areas. However, the ecological risk assessment at these sites assumed 100 percent exposure to reclaimed water and found no significant risk to aquatic organisms. Potentially cumulative projects could not contribute greater than 100 percent exposure, so Project impacts adequately describe total cumulative impacts.

Exposure at the Russian River or Laguna de Santa Rosa. In the Laguna, exposure was assessed at 100 percent effluent, similar to the storage and irrigation sites discussed in the previous paragraph. The *Ecological Risk Assessment* does not show significant risk to aquatic life in the Laguna (EQ less than 5), and cumulative projects could not contribute more than the 100 percent exposure already discussed (Parsons Engineering Science, Inc. 1996).

In the Russian River, the *Ecological Risk Assessment* assumed the maximum design discharge rate of 20 percent of river flow (20 percent exposure). The risk assessment identified an EQ of 9.28 for harbor seals (largely due to aluminum, EQ = 9.21), a less-than-significant impact, but close to the point of significance of EQ = 10 (Parsons Engineering Science, Inc. 1996). Because there are many point and non-point sources of discharge into the Russian River in the cumulative projects list, it is possible that aluminum concentrations may increase enough to cumulatively exceed the EQ = 10 threshold. This is considered a significant cumulative impact.

For other aquatic life besides harbor seals, the *Ecological Risk Assessment* identified an EQ of less than 1.4, far below the point of significance.

Although cumulative projects in the Russian River watershed may increase the concentration of some chemicals evaluated in the risk assessment, contributions from cumulative projects will not be able to increase pollutants in the River sufficient to increase the EQ to 10 or greater (Parsons Engineering Science, Inc. 1996). This is because the concentration of chemicals of concern will need to increase several fold in order to increase risk levels to that extent.

Mitigation: 2.4.16. Ecological Risk Monitoring and Source Control Program. A monitoring plan shall be undertaken to collect additional toxicity data (Kelley Ponds, Russian River) over a two-year period. The data shall be used in an ecological risk assessment to determine if the existing system the Project, and cumulative project discharges will result in an EQ exceeding 10 for harbor seals in the Russian River. If it is determined that the EQ for harbor seal exceeds 10, then the City shall undertake a program to identify sources of aluminum and to reduce the cumulative EQ for aluminum to less than 10.

Aluminum in effluent may be derived from the addition of alum sulfate during wastewater treatment to enhance solids removal and disinfection. Options for reducing aluminum in effluent include substituting ferric chloride or an organic polymer during treatment, identifying primary sources (aside from treatment), and implementing a control program.

SUMMARY OF SIGNIFICANT IMPACTS AND MITIGATION MEASURES

Table 4.9-23

Summary of Significant Impacts and Mitigation Measures - Aquatic Biological Resources

Impact	Level of Significance	Mitigation Measure
Storage Reservoir Component		
9.5.1. The storage reservoir component may cause loss of individuals or occupied habitat of endangered, threatened, or rare aquatic wildlife or plant species.	Alt 2 - ⊙ Alt 3A - ⊙ Alt 3B - ⊙ Alt 3D - ⊙ Alt 3E - ⊙	2.3.11. Sensitive Resource Conservation Program 2.4.4. California Red-legged Frog Capture and Relocation Program

Table 4.9-23

Summary of Significant Impacts and Mitigation Measures - Aquatic Biological Resources

Impact	Level of Significance	Mitigation Measure
9.5.3. The storage reservoir component may cause loss of potential or occupied habitat of aquatic species of concern.	Alt 2A - ⊙ Alt 2C - ⊙	2.3.11. Sensitive Resource Conservation Program
9.5.4. The storage reservoir component may cause permanent loss of sensitive aquatic plant communities and associated wildlife habitats.	Alt 3A - ⊙	2.3.11. Sensitive Resource Conservation Program
9.5.5. The storage reservoir component may cause permanent loss of aquatic habitat.	Alt 2 - ⊙ Alt 3C - ⊙	2.3.11. Sensitive Resource Conservation Program
9.5.6. The storage reservoir component may cause a change in the physical condition of aquatic habitat in the Estero Americano or the Estero de San Antonio within the Gulf of the Farallones National Marine Sanctuary.	Alt 3 - ●	No feasible mitigation has been identified.
9.5.8. The storage reservoir component may cause a change in stream flows, affecting aquatic habitat or aquatic life downstream from proposed dam sites.	Alt 2 - ⊙ Alt 3B - ⊙ Alt 3C - ⊙ Alt 3D - ⊙	2.3.11. Sensitive Resource Conservation Program
Agricultural Irrigation Component		
9.7.6. The agricultural irrigation component may cause a change in the physical condition of aquatic habitat in the Estero Americano or the Estero de San Antonio within the Gulf of the Farallones National Marine Sanctuary.	Alt 3 - ●	No feasible mitigation has been identified.

SUMMARY OF IMPACTS BY ALTERNATIVE

Table 4.9-24

Summary of Impacts by Alternative - Aquatic Biological Resources

Component	Alt 1	Alt 2A	Alt 2B	Alt 2C	Alt 2D	Alt 3A	Alt 3B	Alt 3C	Alt 3D	Alt 3E	Alt 4	Alt 5A	Alt 5B
No Action (No Project) Alternative	○	--	--	--	--	--	--	--	--	--	--	--	--
Headworks Expansion	--	==	==	==	==	==	==	==	==	==	==	==	==
Urban Irrigation	--	==	==	==	==	==	==	==	==	==	--	--	--
Pipelines	--	○	○	○	○	○	○	○	○	○	○	○	--
Storage Reservoirs	--	⊙	⊙	⊙	⊙	●	●	●	●	●	--	--	--
Pump Stations	--	==	==	==	==	==	==	==	==	==	==	--	--
Agricultural Irrigation	--	○	○	○	○	●	●	●	●	●	--	--	--
Geysers Steamfield	--	--	--	--	--	--	--	--	--	--	==	--	--
Discharge	--	○	○	○	○	○	○	○	○	○	○	○	○
Cumulative	●	==	==	==	==	==	==	==	==	⊙	==	⊙	⊙

Source: Harland Bartholomew & Associates, Inc., 1996

Notes: Level of Significance Codes

-- Not applicable

○ Less than significant impact; no mitigation proposed

● Significant impact before and after mitigation

== No impact

⊙ Significant impact; less than significant after mitigation

PREPARERS, REFERENCES, AND CONSULTATION AND COORDINATION

Preparers

Kevin Gusé, Harland Bartholomew & Associates, Inc.
Joyce Hunting, Harland Bartholomew & Associates, Inc.
Wirt Lanning, Harland Bartholomew & Associates, Inc.

Reviewers

Dave Smith, Merritt Smith Consulting
Michael Bumgardner, Harland Bartholomew & Associates, Inc.
Patricia I. Collins, Harland Bartholomew & Associates, Inc.
Robin P. Cort, Ph.D., Parsons Engineering Science, Inc.
Anders J. Hauge, Harland Bartholomew & Associates, Inc.
Jim Buell, Ph.D., Peer Review Committee
John Cummings, Ph.D., Peer Review Committee
David Ziegler, Peer Review Committee

References

HBA Team Documents

Dames and Moore. 1995. *Dam Break Inundation Analysis.* (Appendix J-1).

Harland Bartholomew & Associates, Inc. 1996a. *Biological Resources, Volume 1.* (Appendix K-1).

Harland Bartholomew & Associates, Inc. 1996b. *Biological Resources, Volume 2*, Special Status Species Accounts. (Appendix K-2).

Harland Bartholomew & Associates, Inc. 1996c. *Biological Resources, Volume 4A - Terrestrial Wildlife Habitat and Special Status Wildlife Occurrences on Storage Reservoirs.* (Appendix K-5).

Harland Bartholomew & Associates, Inc. 1996d. *Biological Resources, Volume 4B - Aquatic Habitat and Special Status Aquatic Species Occurrences on Storage Reservoirs.* (Appendix K-5).

Harland Bartholomew & Associates, Inc. 1996e. *Biological Resources, Volume 4C - Vegetation Communities and Special Status Plant Occurrences on Storage Reservoirs.* (Appendix K-5).

Harland Bartholomew & Associates, Inc. 1996f. *Biological Resources, Volume 4D - Irrigation Area Vegetation Communities and Special Status Species Occurrences.* (Appendix K-5)

Harland Bartholomew & Associates, Inc. 1996g. *Biological Resources, Volume 4E - Index to Biological, Aquatic, and Wetland Resources Along Pipelines and Pump Stations.* (Appendix K-5)

Merritt Smith Consulting. 1995. *Anadromous Fish Migration Study Program, 1991-1994.* April 11. (Appendix L-1)

Merritt Smith Consulting. 1996a. *Environmental Conditions in West County Waterways.* June 30. (Appendix I-3)

Merritt Smith Consulting. 1996b. *Aquatic Habitat Survey Results.* June 29. (Appendix L-4)

Merritt Smith Consulting. 1996c. *Stream Crossings Assessment.* June 30. (Appendix I-15)

Merritt Smith Consulting. 1996d. *Aquatic Life Survey Results.* June 30. (Appendix L-5)

Merritt Smith Consulting. 1996e. *Aquatic Biological Resources Impact Analysis Report.* (Appendix L-7)

Merritt Smith Consulting. 1996f. *Anadromous Fish Migration Study Program, 1991-1995.* (Appendix L-2).

Parsons Engineering Science, Inc. 1996. *Ecological Risk Assessment.* (Appendix K-5).

Sycamore Environmental Consultants, Inc. 1996. *Biological Resources, Volume 3.* (Appendix K-3).

Other References

Barnhouse, L. W., G. W. Suter II, S. M. Bartell, J. J. Beauchamp, R. H. Gardner, E. Linder, R. V. O'Neill, and A. E. Rosen. 1986. *User's Manual for Ecological Risk Assessment,* (Environmental Services Division, Oak Ridge National Laboratory, Publication) No. 2679, ORNL-6251.

Brown & Caldwell and Jones & Stokes Associates. 1994. *Petaluma Wastewater Treatment and Storage Facilities Project - Draft Environmental Impact Report.*

Buell and Associates. 1988. *Estero Americano Study, Reclamation Alternative Evaluation. Freshwater Resident/Anadromous Fisheries Developmental Potential.*

California State Coastal Commission. 1987. *Draft Sonoma County Wetlands Enhancement Plan.*

Commins, Marcie, J. Roth, and M. Fawcett. 1990. *Long-Term Detailed Wastewater Reclamation Studies - Santa Rosa Subregional Water Reclamation System* - (Technical Memorandum No. E8A).

Connors, P. G., and J. L. Maron. 1989. *Estero Americano Bird Population Study.* (Long-Term Detailed Wastewater Reclamation Studies Santa Rosa Subregional Water Reclamation System Technical Memorandum No. E13).

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. *Classification of Wetlands and Deepwater Habitats of the United States.* United States Fish and Wildlife Service, Washington, D. C.

De Mars, John, et al. 1977. *Laguna de Santa Rosa Environmental Analysis and Management Plan.* California State College, Sonoma.

EIP Associates. 1990. *Santa Rosa Subregional Water Reclamation System: Long-Term Wastewater System Draft Environmental Impact Report/Statement.*

Elford, C. R. 1964. *Climate of Sonoma County.* United States Department of Commerce, Weather Bureau.

Environmental Science Associates. 1994. *Southeast Regional Wastewater Treatment Plant Facilities Improvements Project and Geysers Effluent Pipeline Project - Draft EIR/EIS (Volume 1 of 2).*

EPA. 1989. *Risk Assessment Guidance for Superfund, Vol. II Environmental Evaluation Manual. Interim Final. USEPA, EPA/54011-89/001.*

Goldman, C. R., and A. J. Horne. 1983. *Limnology.* McGraw-Hill Book Company, San Francisco.

Goodwin, P., and C. K. Cuffe. 1994. *Russian River Estuary Study 1992-1993.*

Grenfell, Jr., W. E. 1988. Valley-foothill riparian. Pages 86-87 *in* Mayer, K. and W. Laudenslayer Jr. (eds.). *A Guide to Wildlife Habitats of California.* California Department of Forestry and Fire Protection, Sacramento, CA.

Harvey, T. 1990. *Evolution of Wetlands in the Estero Americano.* Long-Term Detailed Wastewater Reclamation Studies Santa Rosa Subregional Water Reclamation System Technical Memorandum No. W9.

Jones & Stokes Associates, Inc. 1981. *Ecological Characterization of the Central and Northern California Coastal Region, Volume II, Part 1, Regional Characterization.*

Madrone Associates. 1977. *The Natural Resources of Esteros Americano and de San Antonio.* California Department of Fish & Game, Sacramento, CA.

Menzie, C., J. Cura, J. Freshman, and S. Svirsky. 1993. Evaluating ecological risks and developing remedial objectives at forested wetland systems in New England. Pp. 89-100 in *Application of Ecological Risk Assessment to Hazardous Waste Site Remediation.* Workshop Proceedings. USEPA Science Advisory Board.

PAS & Associates. 1992. *City of Sebastopol General Plan Background Report #3 - Existing Plans, Environment and Infrastructure.*

Prunuske Chatham, Inc. 1994. *Stemple Creek/Estero de San Antonio Watershed Enhancement Plan.*

Roth, J., M. Commins, M. Fawcett, and R. Maddox. 1993. *Steelhead Trout Migration in Mark West Creek and Santa Rosa Creek, 1991-1993. Laguna de Santa Rosa Intensive Monitoring Program Draft Technical Memorandum.*

Schoenherr, A. A. 1992. *A Natural History of California.* University of California Press, Berkeley and Los Angeles, California.

Serpa, L. 1991. *Stemple Creek Rare Invertebrate Survey.*

Serpa, L. 1995. *Survey for the California Freshwater Shrimp (Syncaris pacifica) at proposed reservoir sites for the Santa Rosa Wastewater Project.*

Smith, David W. Consulting & CH2M Hill. 1988. *Status Report - Reclamation Alternative Evaluation - Estero Americano Environmental Studies.*

Smith, David W. Consulting & CH2M HILL. 1990. *History, Land Uses and Natural Resources of the Laguna de Santa Rosa.*

United States Fish and Wildlife Service. 1981. *Pacific Coast Ecological Inventory, Santa Rosa, California.*

Watkin, G. E., and M. E. Stelljes. 1993. *A Proposed Approach to Quantitatively Assess Potential Ecological Impacts to Terrestrial Receptors from Chemical Exposure, Environmental Toxicology and Risk Assessment: 2nd Volume, STP 1216,*

J. W. Gorsuch, F. J. Dwyer, C. G. Ingersoll, and T. W. La Point, eds., American Society for Testing and Materials, Philadelphia.

Will, M. E. and G. W. Suter II. 1994. *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process.* Oak Ridge National Laboratory, Environmental Sciences Division. ES/ER/TM-126.

Consultation and Coordination

Persons Contacted

N/A	Marin County Agricultural Commission
N/A	California Department of Water Resources
N/A	Sonoma County Farmlands Group
Pat Balderama	Marin County Planning Department
David Bannister	Sierra Club (Marin Chapter)
Bob Barnes	National Audubon Society - Sacramento
Fred Bottie	California Department of Fish & Game, Region 3 (Yountville)
Marsha Brockbank	San Francisco Bay Estuary Project
Betty Burridge	Sonoma County Breeding Bird Atlas Administrator
Jim Bybee	National Marine Fisheries Sanctuary - Gulf of Farallones
Michael Carlan	San Francisco Water Quality Control Board
Richard Charter	Sonoma County Land Trust
Bill Cox	California Department of Fish & Game - Region 3 (Yountville)
Dennis Dorch	Cotati Planning Department
Rich Eastabrook	Bureau of Land Management
Gary Fellers	Point Reyes National Seashore
Steve Ford	California Department of Water Resources (Central District) - Environmental Program Manager
Joe Gaffney	Rohnert Park Community Development Department
Bob Gaiser	Sonoma County Planning Department
Barry Garrison	California Department of Fish and Game - Hardwoods Coordinator
Jesse Grantham	National Audubon Society (Sanctuaries)
Ron Keith	Mosquito Abatement District (Marin & Sonoma County)
Jan Knight	United States Fish & Wildlife Service
Joe Le Claire	San Francisco Bay Conservation & Development Commission
Laurel Marcus	State Coastal Conservancy
Dave Mattens	National Marine Fisheries Service

Darlene McGriff	California Department of Fish & Game, Natural Heritage Division
Carolyn McLain	University of California Cooperative Extension - Sonoma County
Ed Morris	California Department of Water Resources
Phil Northen	Sonoma State University (Herpetologist)
Dave Plummer	State Lands Commission
Barbara Salzman	Sierra Club
Ceil Scandone	Association of Bay Area Governments
Lisa Shanks	National Resource Conservation Service
Steve Sharp	California Association of Local Agency Formation Commission
Ken Stelling	U.S. Department of the Interior, Division of Oil & Gas
Kristin Tarp	United States Fish & Wildlife Service, Sacramento
Ed Ueber	National Oceanic and Atmospheric Association
Bill Van Beckum	CA Coastal Commission
Tuck Vath	State Water Resources Control Board
Robert Verner	Marin Agricultural Land Trust
Allison Willy	United States Fish & Wildlife Service, Sacramento
Larry Wycoff	California Department of Fish & Game, Sacramento
Kurt Yeiter	Petaluma Planning Department
Rick York	California Energy Commission

Correspondence

Ed Ueber, NOAA, June 14, 1995.

Jim Bybee, NMFS, June 12, 1995, June 13, 1995.

Dale A. Pierce, Acting Field Supervisor, United States Fish and Wildlife Service, Ecological Services, Sacramento Field Office. Reference number 1-1-94-TA-409, February 9, 1994.

Joel A Medlin, Field Supervisor, United States Fish and Wildlife Service, Ecological Services, Sacramento Field Office, Reference number PPN 364, June 22, 1995.

Ruth Pratt, United States Fish and Wildlife Service, January 24, 1996.

Susan Lawrence, Biologist, United States Fish and Wildlife Service, Arlington, VA, November 30, 1995.

Eilene Stone, United States Fish and Wildlife Service, OR, November 29, 1994, December 20, 1994.

Brian Tweit, United States Fish and Wildlife Service, Sacramento, CA, November 16, 1994, November 18, 1994.

Kelly Geer, United States Fish and Wildlife Service, Sacramento, CA, November 17, 1994.

Allison Willy, United States Fish and Wildlife Service, Sacramento, CA, November 16, 1994, September 14, 1995.

Meri Moore, United States Fish and Wildlife Service, Sacramento, CA, January 22 or 23, 1996.

Ruth Pratt, United States Fish and Wildlife Service, January 22, 1996, January 23, 1996, January 24, 1996.

Donna Hummel, United States Fish and Wildlife Service, Sacramento, CA, March 22, 1995.

Karen Miller, United States Fish and Wildlife Service, Sacramento, CA, July 11, 1996.

Debbie Osborne, California Department of Fish and Game, November 17, 1994, November 18, 1994, December 20, 1994, December 30, 1994.

John Brode, Biologist, California Department of Fish and Game, Region II, November 16, 1994, November 17, 1994, November 18, 1994, November 21, 1994.

Bill Cox, Biologist, California Department of Fish and Game Region III, November 16, 1994, November 17, 1994, June 12, 1995, June 14, 1995, June 16, 1995.

Fred Bottie, California Department of Fish and Game Region III, September 18, 1995.

Celeste Cushman, California Department of Fish and Game-CNDDB, Sacramento, CA, March 22, 1995.

Kevin Hunting, Biologist, California Department of Fish and Game, Sacramento, CA, September 14, 1995.

Darlene McGriff, Mammalogist, California Department of Fish and Game-CNDDB, Sacramento, CA, September 14, 1995.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

4.10 JURISDICTIONAL WETLANDS RESOURCES

This section discusses Project impacts on jurisdictional wetlands within the areas of direct impacts, which are the construction zones of the Project components, as well as within the area of indirect impacts which encompasses watersheds potentially affected by Project components. The jurisdictional wetlands addressed in this section are those regulated by Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899. An overview of the regulatory environment for wetlands is provided, including regulations for filling of wetlands. The biological and physical characteristics of wetlands are described, and temporary and permanent loss of potential jurisdictional waters from fill are quantified. Secondary impacts, including effects on non-jurisdictional wetlands are also discussed. To provide a basis for this evaluation, functions and values of potential jurisdictional wetlands are identified. Wetland resources are categorized according to wetland community types and wetland habitat types.

IMPACTS EVALUATED IN OTHER SECTIONS

The following subjects are related to the Jurisdictional Wetlands Resources Section, but are evaluated in other sections of this document:

- Alteration of Surface Water Quality. Operation of irrigation systems, storage reservoirs, and discharge into the Russian River may affect water quality in existing wetlands and other waters of the U.S. Impacts relating to surface water quality due to the implementation of Project alternatives are discussed in Section 4.6, Surface Water Quality.
- Effects on Streams. Project effects on streams are evaluated in several different sections. Streambed erosion and flooding are discussed in Section 4.4, Surface Water Hydrology. Interruption and redirection of stream flow by reservoirs is discussed in Section 4.4, Surface Water Hydrology and Section 4.6, Surface Water Quality. Effects on streams due to seepage of reclaimed water out of the bottom of storage reservoirs are evaluated in Section 4.6, Surface Water Quality, Section 4.9, Aquatic Biological Resource Section and Section 4.5, Groundwater.
- Effects on Fisheries. Potential impacts to fisheries are evaluated in Section 4.9, Aquatic Biologic Resources.
- Effects on Vegetation and Wildlife. Discharge of dredge and fill material into wetlands and inundation of storage reservoir sites with reclaimed water would

affect wetland-associated wildlife and vegetation. Impacts relating to vegetation and wildlife due to the implementation of Project alternatives are discussed in Sections 4.8 and 4.9, Terrestrial and Aquatic Biological Resources, respectively.

- Effects of Agricultural Application of Reclaimed Water on Wetland Communities is discussed in Sections 4.8, and 4.9, Terrestrial and Aquatic Biological Resources.
- Effects on Cultural Resources Resulting From the Discharge of Dredge and Fill into Wetlands and Other Waters of the U.S. Impacts relating to cultural resources due to the implementation of Project alternatives are discussed in Section 4.15, Cultural Resources and Paleontology.
- Changes in the Recreational Use of Surface Waters. Impacts to recreation due to the implementation of Project alternatives are discussed in Section 4.16, Public Services, Utilities, and Recreation and Section 4.18, Socio-economics.

AFFECTED ENVIRONMENT (SETTING)

The affected environment for the Project alternatives includes the jurisdictional waters within the Area of Indirect Impacts depicted in Figure 4.8-1. The Area of Indirect Impacts encompasses the watersheds potentially affected by proposed Project components such as storage reservoirs, discharge, and agricultural irrigation. Watersheds located within the Area of Indirect Impacts include, but are not limited to, the areas drained by the Laguna de Santa Rosa, Russian River, Petaluma River, Estero Americano, and Estero de San Antonio. The Area of Direct Impacts only includes the construction boundary zones of the proposed Project components.

Regulatory Environment

Activities affecting "waters of the United States" are regulated by Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899. This regulatory authority is administered by the U.S. Army Corps of Engineers (Corps). Waters of the U.S. include territorial seas, all waters that have been or could be used in connection with any interstate commerce (including recreation), navigable waters, adjacent wetlands and tributaries, and other intrastate or isolated waters whose degradation or destruction could affect interstate or foreign commerce. Wetlands and other jurisdictional waters of the U.S. could be affected by the construction, operation, and maintenance of elements of Project alternatives presented in this EIR/EIS. In order to carry out environmental review of Project elements that will require Section 404 and/or Section 10 permitting, the Corps has assumed the responsibility of federal lead agency for the EIR/EIS process.

Some secondary impacts on wetlands and other waters of the U.S. that may result from Projects involving the discharge of dredged or fill material are subject to the Section 404 and/or Section 10 permit process, while others are not. The latter impacts, including but

not limited to effects on non-jurisdictional wetlands, are not directly subject to Corps regulatory authority under Section 404 but still must be evaluated in an EIR/EIS to meet California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA) requirements and will also be considered by the Corps during the permitting process. Secondary, indirect and cumulative impacts not subject to Section 404 jurisdiction are evaluated in other related sections of this document.

The following subsections present several key topics from the Corps' Section 404 regulatory program relevant to the Project alternatives and the impact analysis. Comprehensive discussions of the Section 404 permitting program can be found in the following reports: *Planning Level Wetland Determination Report for Proposed Reservoir Sites* (Parsons Engineering Science, Inc. 1996c), *Wetland Determination and Mitigation for Proposed Pipeline Alignments* (Parsons Engineering Science, Inc. 1996b), and *Agricultural Irrigation Areas Wetlands Determination* (Parsons Engineering Science, Inc. 1996a).

Waters of the U.S.

The Clean Water Act regulates discharges of dredged or fill material into waters of the U.S., which are broadly defined to include all waters whose alteration could or does influence interstate commerce, including migratory bird habitat. These waters, as defined in 33 CFR 328.3, include the following which apply to the Project alternatives:

- All waters currently used, used in the past, or susceptible to use in interstate or foreign commerce, including all waters subject to tidal influence;
- All other waters, such as intrastate lakes, rivers, streams, mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or ponds, whose use or degradation could affect interstate or foreign commerce (this includes waters with the potential to be used for recreation, commercial shellfishing, or industry);
- All impoundments of U.S. waters;
- All tributaries of U.S. waters (including both perennial and intermittent streams);
- Wetlands adjacent to U.S. waters.

Two other groups not associated with the Area of Indirect Impacts, are territorial seas and interstate waters. Waters of the U.S. extend "landward to the ordinary high water mark in non-tidal systems, adjacent to the high tide line in tidal

systems, and to the landward extent of wetlands that may lie upslope of the ordinary high water mark or high tide line" (33 CFR 328.4). Floodplains are not waters of the U.S., unless they fall into one of the groups listed above.

Navigable Waters of the U.S.

Navigable waters of the U.S. include "those waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce" (33 CFR 329.4). The landward side of navigable waters is defined by the ordinary high water mark in non-tidal areas and by the mean high water mark in tidal areas. Section 10 (River and Harbors Act) permits are required for activities that might affect interstate commerce in navigable waters, and applies to lower segments of the Russian River and to the Estero Americano and Estero de San Antonio.

Special Aquatic Sites and Wetlands

Special consideration is given by the Corps to discharges affecting "special aquatic sites." "Special aquatic sites" are defined as "geographic areas, large or small, possessing special ecological characteristics of productivity, habitat, wildlife protection, or other important and easily disrupted ecological values." These areas are generally recognized as "significantly influencing or positively contributing to the general overall environmental health or vitality of the entire ecosystem or region" (40 CFR 230.3 (q-1)). Sanctuaries and refuges, wetlands, mudflats, vegetated shallows, coral reefs, and riffle and pool complexes are all considered to be special aquatic sites (40 CFR 230.40-.45).

Wetlands

The Corps and the EPA define wetlands as: "Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas" (33 CFR 328.3).

An area must meet specific criteria for hydrophytic vegetation, hydric soils, and wetland hydrology as defined in the Corps' 1987 Wetland Delineation Manual, referred to herein as the 1987 Manual (Environmental Laboratory 1987), to be classified as a jurisdictional wetland. Areas subject to grazing or which do not exhibit indicators of all three mandatory criteria year-round or for which one of the criteria may be missing are classified as "Problem Areas" by the Corps. Areas supporting seasonal wetlands, a common wetland type throughout the Area of

Direct Impacts, are classified as "Problem Areas" because hydrophytic vegetation and wetland hydrology may not be present year-round. The Corps has developed special identification procedures for wetland determinations of "Problem Areas."

Human-induced wetlands are another class of wetlands with special identification criteria outlined in the 1987 Manual. A human-induced wetland is "an area that has developed at least some characteristics of naturally occurring wetlands due to either intentional or incidental human activities. Examples of man-induced wetlands include wetlands resulting from irrigation, wetlands resulting from filling of former deepwater habitats, dredged material disposal areas, portions of stock ponds and wetlands resulting from stream channel realignment" (Environmental Laboratory 1987). Many types of wetlands created or maintained by human activities fall under Corps jurisdiction. However, in general, human-induced wetlands created on dry land and maintained solely by direct application of pumped or actively diverted water are excluded from Corps jurisdiction.

Wetlands on Agricultural Land

Although regulatory authority under Section 404 rests with the Corps, the responsibility for determination of jurisdictional status on agricultural land is shared with the Natural Resources Conservation Service (NRCS) throughout the U.S., with the exception of the nine counties of the San Francisco Bay area, including Marin and Sonoma.

In a Memorandum of Agreement signed in January 1994 by the Corps and the NRCS, the Corps allocated responsibility for making joint wetlands determinations and delineations on agricultural lands to the NRCS "whether or not the person who owns, manages or operates the land is a participant in USDA programs." Implementation of the Memorandum of Agreement in the nine counties of the San Francisco Bay area including Marin and Sonoma has not yet occurred. In these counties, the Corps retains wetland delineation responsibility for agricultural lands for Section 404 purposes.

The following information is provided regarding the NRCS program, because the Corps may consider these issues in their actions.

The 1985 "Swampbuster" provisions of the Food Security Act restrict federal farm benefits for farmers who convert wetlands to croplands. The NRCS is responsible for administering these provisions, including monitoring farming activity. Federal farm benefits may be withheld if provisions of the Food Security Act are not met. Exemptions may be granted for wetlands conversions occurring prior to December 23, 1985, the date of adoption of the Swampbuster Provisions.

The NRCS National Food Security Act Manual, 3rd Edition (1994) provides guidance for classifying wetlands on agricultural land and identifies permissible activities under the various classifications. The National Food Security Act Manual provides the following definition of "prior converted cropland":

> "wetlands that were drained, dredged, filled, or otherwise manipulated, including the removal of woody vegetation, before December 23, 1985, for the purpose [of making].... the production of an agricultural commodity possible, and an agricultural commodity was planted or produced at least once prior to December 23, 1985."

Prior converted croplands, as defined by the NRCS, are excluded from Corps jurisdiction while active cultivation continues and the conditions necessary to support a prevalence of hydrophytic vegetation (specifically, sustained inundation) are absent.

> "Waters of the U.S. do not include prior converted cropland. Notwithstanding the determination of an area's status as prior converted cropland by any other federal agency, for the purpose of the Clean Water Act, the final authority regarding Clean Water Act jurisdiction remains with the EPA (40 CFR Part 232.2)."

Areas of abandoned prior converted cropland, where wetland conditions return, are regarded as jurisdictional wetlands.

"Farmed wetlands" are defined in the National Food Security Act Manual as "wetlands that were manipulated and cropped prior to December 23, 1985, but which continue to exhibit important wetland values." Farmed wetlands meet the regulatory definition of wetlands and are subject to Section 404 provisions.

Section 404 Permit Program

Project proponents wishing to engage in most activities affecting waters of the U.S., such as dredging or filling, are required to obtain a Section 404 permit from the Corps. Regulated activities that potentially apply to the Project alternatives are:

- Emplacement of dams or dikes in navigable waters (33 CFR 321);
- Other excavation, dredging or disposal activities in navigable waters (33 CFR 322);

- Activities that alter the course, condition, capacity etc. of navigable waters (33 CFR 322);
- Discharges of dredged or fill material into the waters of the U.S. (33 CFR 322); and
- Excavation in waters of the U.S. (33 CFR 323.2(d); 58 FR 45008-45038).

Reservoir construction would involve direct fill of wetlands in conjunction with dam structures as well as excavation, dredging, and disposal activities. Inundation (backwater flooding) of the reservoir sites or alteration of downstream flows due to placement of fill in jurisdictional waters (dam construction) would be considered consequent impacts subject to Section 404 jurisdiction. Inundation resulting solely from the discharge of reclaimed water is subject to other sections of the Clean Water Act. Construction of pipelines and outfall structures may require fill of wetlands and waters of the U.S.

The Corps has the authority under Section 404 to issue two types of permits for discharges of dredged or fill material into jurisdictional waters: general and individual permits. General permits authorize all activities that are of the type specified by the permit, lie within the regional limitations of the permit, fall within limitations on the nature and extent (volume or area) of fill material, and comply with all general and specific conditions, including requirements for notification of the Corps and other authorities. Nationwide permits are a category of general permits that have been issued for certain specified activities that have been determined individually and collectively to have minimal impacts. However, it is recognized that in some localities or under certain circumstances, some actions that are of the types specified by nationwide permits may have more than minimal effects. Therefore, the district engineer has the discretion to require an individual permit for any action subject to Section 404, or to add special conditions to authorizations issued under existing general or nationwide permits, as necessary to satisfy legal requirements or otherwise protect the public interest. If the conditions are met, the specified activities can take place without the need for an individual permit.

Section 404 permit applications are subject to review by the public and by other agencies including:

- The U.S. Environmental Protection Agency (EPA);
- The U.S. Fish and Wildlife Service (USFWS);
- The National Marine Fisheries Service (NMFS); and
- Appropriate state and local agencies.

Other federal agencies may be involved in the review process depending upon the particular Project. Federal laws and Executive Orders that may affect the processing of a permit application include NEPA, the Coastal Zone Management Act, the Fish and Wildlife Coordination Act, the Federal Endangered Species Act, the National Historic Preservation Act, the Deepwater Port Act, the Federal Power Act, the Marine Mammal Protection Act, the Wild and Scenic Rivers Act, Executive Order 1198 (Floodplain Management), Executive Order 11990 (Protection of Wetlands), Section 6(f) of the Land and Water Conservation Act, the Farmland Protection Policy Act, the Migratory Bird Treaty Act, the Food Security Act, and the National Fishing Enhancement Act of 1984.

Other Regulatory Requirements

Although this section discusses waters of the U.S. from the perspective of the Corps' regulatory authority, there are other federal and state regulations that influence activities in wetlands and other waters of the U.S. The following section provides a brief overview of additional state and federal regulations involving wetlands and other waters of the U.S.

State agencies with permitting or review authority over jurisdictional wetlands, and other waters of the U.S. include the California Department of Fish and Game (CDFG), Regional Water Quality Control Boards, and the California Coastal Commission. Although not discretionary, Streambed Alteration Agreements (Section 1601/1603 CCR), issued by the California Department of Fish and Game, are required for alterations to rivers, streams, or lakes. These agreements stipulate measures that must be taken to mitigate the impact of construction activities in potentially affected waterways. Restrictions may be placed on the timing, duration, and extent of activities to minimize the potential disturbance to fish and wildlife resources.

A Coastal Zone Development Permit must be obtained for any structures built in the Coastal Zone. The Local Coastal Plan designates the Coastal Zone, the width of which varies considerably. Portions of the Coastal Zone included in the Local Coastal Plan for Sonoma County are the Valley Ford area and the Esteros Americano and de San Antonio. The Sonoma County Board of Supervisors grants Coastal Zone Development Permits. This permit would be required for all Project facilities proposed within the Coastal Zone. Decisions made by the County Board of Supervisors may be appealed to the California Coastal Commission.

Activities permitted under Section 404 or Section 10 must be consistent with the Federal Coastal Zone Management Act. An applicant must submit certification to the Corps that the Project's activity is consistent with the Local Coastal Plan. The Corps District Engineer shall not issue a permit until the Coastal Commission concurs with this certification. This process applies not only to development along the coast, but to all actions which could indirectly impact coastal resources.

Section 401 of the Clean Water Act requires the appropriate Regional Water Quality Control Board to certify that water quality would not be adversely affected by the proposed fill activity to be permitted under Section 404. The Corps may not issue a Section 404 permits without a 401 certification or a waiver of certification that the discharge complies with state water quality standards.

Functions and Values of Potential Jurisdictional Wetlands

Under Section 404 of the Clean Water Act, alterations of functional value of jurisdictional waters must be considered by the Corps in the permitting process. Wetlands and other waters of the U.S. perform a variety of functions in the physical and biological environments, which may be altered directly or indirectly by Project components, whether or not wetland acreage is filled, drained, or inundated. Where wetland fills are required by Project components, qualitative understanding of the functions and values of that acreage is one facet of analyzing impacts and developing mitigation. Eleven wetland functions and values are identified by the Wetland Evaluation Technique (Adamus *et al.* 1987). Some of these (e.g., recreation) are not, or only minimally, characteristic of wetlands and other waters of the U.S. within the Area of Indirect Impacts. Applicable primary functions and values of wetlands (and other waters of the U.S., found within the Area of Indirect Impacts) are:

- Subsurface hydrology (groundwater recharge);
- Surface hydrology (attenuation of flood flows and, in the case of riparian wetlands in low-gradient environments, bank storage, extending the duration of late-season low flows);
- Surface water quality (sediment retention and stabilization; removal of nutrients by wetland vegetation; and adsorption and immobilization of other pollutants by clay and soil microorganisms); and
- Habitat (food and water source, breeding habitat, and thermal and visual cover for general wildlife and many special-status species).

Any particular wetland may have one or more of these functions and values. Some wetlands, notably isolated ones with a relatively short season of near-surface saturation and vegetation dominated by non-native wetland species, perform functions that are only marginally different from those of surrounding uplands.

Avoidance and minimization of wetlands impacts where practicable, are considered the primary mitigation actions for wetlands. Compensation mitigation is considered only after these actions have been thoroughly explored. The order of preference of wetland compensation mitigation actions is based upon the principle of replacement not only of acreage but also of functions and values. Thus, where wetlands are to be filled, lost functions and values are usually best replaced if mitigation provides for creation of habitat in kind (similar to that which was lost), on or near the site of impact. Creation of different habitat (out-of-kind compensation) on or near the impact site is next most preferable, followed by in-kind, off-site mitigation; and finally out-of-kind, off-site mitigation. Where habitat is to be created off-site, it is often preferable for mitigation to occur within the same watershed because, as can be seen from the list of common functions above, functions relating to water quality and quantity (and, to a lesser extent, habitat) have benefits within a particular watershed. However, exceptions to these general principles are appropriate where the overall benefits of a mitigation opportunity are much greater than those that can be realized by an opportunity for in-kind, on-site mitigation (for example, in relationship to other sensitive, scarce, productive, or especially diverse habitats in the same region or watershed). Such benefits may relate to any or all of the common functions and values listed above.

Regional Wetlands Resources

Sonoma and Marin counties are rich in wetland resources. Several large watersheds are located within the Area of Indirect Impacts. Numerous small intermittent and perennial creeks and streams serve as tributaries to larger riverine systems which meander to the Pacific Ocean through estuaries and bays. Freshwater springs and seeps occur along hillsides and support perennial wetland systems. Isolated wetlands form in shallow depressions on valley floors and terraces fed by winter rains and floodwaters.

Regional wetland plant community types are described below and are based on a vegetation classification system that incorporates systems developed by Holland (Holland 1986) and Shuford and Timossi (Shuford and Timossi 1989). The classification system was developed to accurately reflect the wetland resources of the region.

Table 4.10-1 presents regional wetland habitat types and other functional habitat classification systems. The table compares classification systems including Classification of Wetlands and Deepwater Habitats of the U.S. (Cowardin et. al. 1979) and a Guide to Wildlife Habitats of California (Mayer and Laudenslayer 1988). Cowardin et. al. provides a nationwide wetlands classification system developed to inventory national aquatic ecosystems. Wetlands are hierarchically grouped in this system by similarity of hydrologic, geomorphic, chemical, and biological factors. Wetlands also provide important habitat for many terrestrial wildlife species. Mayer and Laudenslayer provides a classification system for aquatic wildlife habitat. The corresponding geomorphic and hydrodynamic properties of these wetland types, as well as their potential functions, as

interpreted from the Hydrogeomorphic Classification for Wetlands (Brinson 1993), are also provided.

Annual Grassland Wetlands

Annual grassland wetlands include a mixture of obligate and facultative wetland plants. Wetland plant species are classified as either obligate (they almost always occur in wetlands), facultative wetland (plants occur in wetlands 67-99 percent of the time), facultative (plants have an equal probability 33-66 percent chance of occurring in wetlands or uplands), and facultative or obligate upland (plants occur in wetlands 1-33 percent of the time) (Reed 1988). Annual grassland wetlands dominated by facultative plants with some obligate and facultative wetland plants were the most common wetland type observed throughout the Project area.

Annual grassland wetlands primarily occur on unconsolidated materials located on valley floors, basins, elevated stream terraces, lower alluvial fans and flat areas at the base of slopes. The wetland/upland boundary in these communities was determined to be where a prevalence of the hydrophytic species listed above shifted to a prevalence of upland and facultative upland species.

Smaller areas of native grassland wetlands also occur within the Project area. These areas represent the character of grasslands within the Project area before the introduction of annual grasses from Europe. For the purposes of analysis, native grassland wetlands are included with annual grassland wetlands because the hydrology and soils of these areas are similar to annual grassland wetlands and the acreage encountered in the Project was minimal.

Coastal Brackish Marsh

Coastal brackish marsh contains elements from salt marsh and freshwater marsh plant communities. This community has adapted to a unique set of ecological conditions including seasonal variations in inundation areas, variable salinity concentration, changing hydrology due to seasonal flooding, and periodic desiccation. Salinity may vary considerably, and may increase at high tide or during seasons of low freshwater runoff. Coastal brackish marsh gradually intergrades with coastal salt marsh toward the ocean and along the interior edges of coastal bays, estuaries, and coastal lagoons. Occasionally, brackish marsh intergrades with freshwater marsh at the mouths of rivers (Madrone Associates 1977). Within the Area of Indirect Impacts, brackish marsh is found on the upper reaches of the Estero Americano and the Estero de San Antonio.

Coastal Salt Marsh

Coastal salt marsh communities are tidally influenced emergent wetland habitats dominated by salt tolerant plants. Salt marshes are usually found in sheltered inland margins of bays, lagoons, and estuaries (Holland 1986) and are characterized by the presence of perennial emergent grasses, succulent herbs, and suffrutescent shrubs (herbaceous above, with a woody base). Salinity levels in salt marshes vary spatially and temporally, increasing in dry summer months or at high tide and decreasing during periods of high freshwater inflow. Species composition and densities are influenced by the salinity of the supporting water matrix. The very salt-tolerant cord grass (*Spartina* sp.) may dominate communities near open waters, while pickleweed often dominates in the near-shore zones.

Salt marsh communities occur at several locations within the Area of Indirect Impact. The most extensive salt marsh communities are associated with the mouths of the Estero Americano and Estero de San Antonio. In addition, salt marsh habitat occurs along the lower reaches of Walker Creek where it flows into Tomales Bay, and along the lower Petaluma River in Marin County where it enters San Pablo Bay.

Cropland Wetlands

Cropland wetlands include wetlands currently in agricultural production that are subject to periodic inundation or saturation or have exhibited jurisdictional wetland characteristics in the past. Crop types classified as "cropland" include oat hay. Continuously cropped areas that exhibited wetland characteristics in the past, but were modified prior to 1985 in ways that eliminate wetland hydrology may be considered prior converted croplands, and are not subject to Section 404 jurisdiction unless abandoned. Cropped areas that are not hydrologically altered and continue to experience inundation in most years are considered farmed wetlands. Existing cropping activities are permitted, but may be subject to Section 404 jurisdiction if a conversion to another use occurs.

Drainages

Drainages are channels or low spots in the landscape which collect runoff and groundwater discharge and convey surface water for a few days to a few months every year. Most of the low-order, high gradient streams within the Project area which are mapped as blue lines on U.S. Geologic Service topographic quadrangles were classified as drainages. Drainages range from as narrow as one foot to approximately ten feet wide and may or may not be vegetated. Most drainages occur as well defined sandy or gravely flat bottomed channels largely

devoid of vegetation. Many of these are potential jurisdictional waters of the U.S. but not wetlands, since they would not normally support vegetation and by definition a wetland must be capable of supporting vegetation. Other drainages support discontinuous clumps of vegetation around areas of prolonged ponding or saturation similar to that found in freshwater seep wetlands.

Excavated Drainages

Realigned historic drainages that receive sufficient precipitation or runoff to maintain the characteristics of a water of the U.S. also fall under Section 404 jurisdiction. Several excavated drainages are located on the proposed Tolay Reservoir site, including Tolay Creek and its tributaries, which are actually realigned historic drainages that continue to function biologically as wetlands. Typical excavated drainage wetland vegetation is similar to that found along drainages, non-wooded riparian areas, and freshwater marsh.

Freshwater Marsh

This wetland type contains vegetation adapted to perennially wet conditions. Cattails and tules occur in deeper water and baltic rush, spike rush and nutsedge occur along the moist margins. Freshwater marsh wetlands are found in association with perennial streams and around farm ponds. Natural lakes and ponds are rare in the Project area. However, the valley floor of the proposed Tolay storage site formerly supported a large seasonal lake and associated freshwater marsh vegetation.

Freshwater Ponds

Most ponds and lakes in Sonoma County are artificial, and were created using impoundments constructed to collect overland runoff and surface water flows in natural drainages. Water from these artificial ponds is often used for stock watering and agricultural irrigation. Stockponds function as freshwater pond wetlands and have been included as potential jurisdictional waters of the U.S. because the vast majority impound natural drainages or have been excavated in areas that were formerly freshwater seeps or annual grassland wetlands. The quality of wetland and aquatic habitat provided by stockponds or freshwater pond wetlands varies tremendously. Bands of emergent vegetation occur along the fringe of some stock ponds, while others are unvegetated due to heavy livestock grazing around their margins or wide fluctuations in water level. Cattails, spike rush, tules and a variety of willows are may be found around the edges of stockponds.

Freshwater Seeps

Freshwater seep wetlands form where high seasonal groundwater reaches the surface, and they are easily identified because they stay green into the summer long past the surrounding upland annual grasses. Freshwater seeps are typically inundated or saturated longer than annual grassland wetlands. Spring boxes have been installed in many seeps within the Project area for livestock watering.

Mixed Riparian Woodland

Mixed riparian woodlands are associated with perennial or intermittent streams and contain broad-leaved, closed canopied deciduous trees and an extensive understory of shade tolerant shrubs.

Many areas of woody riparian vegetation, especially where degradation of the channel has lowered the groundwater level, do not meet the mandatory wetland hydrology criterion and therefore are not under Corps 404 jurisdiction. The upper edges of riparian corridors, are non-wetlands and commonly support California bay, live oak, oak, and buckeye which intergrade into annual grasslands.

Non-wooded Riparian Wetlands

These are well defined channels, generally wider than ten feet, that once supported riparian shrubs or trees that have since been eliminated by grazing or other disturbance. Non-wooded riparian wetlands are most often vegetated with a scattering of annual herbaceous species much like those that are found in annual grassland wetlands.

Seasonally Wet Vegetation Wetlands

Seasonally wet vegetation wetlands are an intermediate classification between vernal pools and annual grassland wetlands. The period of inundation separates the three types of seasonally inundated wetlands. Vernal pools hold water the longest and contain the highest diversity of native, endemic species, and annual grassland wetlands hold water for a shorter length of time and contain more non-native species. Seasonally wet vegetation is found in depressions in the landscape such as swales and basin floors that briefly pond water in the winter and spring or that become saturated by perched near-surface groundwater.

Vernal Pools

Vernal pools occur in depressions in grasslands and other habitats that are underlain with an impervious soil layer. These depressions fill with water in the winter and slowly dry in the spring and summer. Vernal pools are classified according to the substrate on which they occur. These substrates include terrace soils, volcanic mudflows, and clay hardpan.

The vegetation of vernal pools is generally characterized by springtime dominance of native annual plants, often providing striking wildflower displays. As water in the vernal pools recedes during the spring, vernal pool annual plants begin to germinate and grow. Rings of species adapted to different physical conditions flower in succession.

Willow Riparian Wetlands

Willow riparian wetlands commonly are composed of dense thickets of willow (*Salix laevigata*) and arroyo willow (*Salix lasiolepis*) with little or no understory. Willow riparian wetlands generally occur within and immediately along stream courses and other locations where surface water or groundwater seeps are near the surface. Willow riparian wetland communities commonly occur on freshly deposited sand and silt soils on flood plains. Because these communities commonly occur in locations of permanent or semi-permanent moisture and they provide shade and forage throughout the year, they tend to attract livestock and are often severely degraded.

Undetermined Wetland Type

Portions of the bay lands were not accessible for on-site surveys. Therefore, color aerial photos (3x3 inch color slides from April, 1994) were used to map and evaluate the wetland communities. Although wetland areas were discernible on the photos, it was not possible to determine the type of wetland habitat present, so these areas were mapped as "undetermined wetland type."

Table 4.10-1

Regional Wetland Habitat Types and Functional Habitat Classification Systems

Wetland Plant Community Type (Shuford and Timossi/Holland)[1]	Wetland Classification (Cowardin)[2]	Wetland Wildlife Habitat (Mayer and Laudenslayer)[3]	Physical Wetland Classification (Brinson)[4]
Annual grassland wetlands	Palustrine[5], emergent wetland, seasonally flooded	Annual grassland	**Geomorphic Setting.** Retains inflow, loss is primarily by evapotranspiration. Subject to wide fluctuation in water depth. Geographic location critical to migrating waterfowl as flyway position indicates. Changes in vegetation create varied waterfowl habitat. **Water Source.** Water supplies support vegetative complexity and habitat structure not found in uplands because of water stress in arid climate. **Hydrodynamic Properties.** Precipitation and evapotranspiration dominate site water balance. Floodwaters retained by depressions. Fluctuating water table conducive to rapid biogeochemical cycling; strong atmospheric exchanges.
Coastal brackish marsh	Estuarine, intertidal, emergent wetland, irregularly flooded	Estuarine	See coastal salt marsh below.
Coastal salt marsh	Estuarine, intertidal, emergent wetland, irregularly flooded	Saline emergent wetland	**Geomorphic Setting.** Barrier to saltwater encroachment; accommodates sediment deposition; open to estuarine organisms for feeding and recruitment. **Water Source.** Filled by precipitation, groundwater, and lateral surface or near surface water transport. High primary production occurs when water is abundant. **Hydrodynamic Properties.** Very active region for biogeochemical process and estuarine food web support.

Table 4.10-1

Regional Wetland Habitat Types and Functional Habitat Classification Systems

Wetland Plant Community Type (Shuford and Timossi/Holland)[1]	Wetland Classification (Cowardin)[2]	Wetland Wildlife Habitat (Mayer and Laudenslayer)[3]	Physical Wetland Classification (Brinson)[4]
Cropland wetland	Palustrine, emergent wetland, seasonally flooded	Cropland	See annual grassland wetlands.
Drainages	Riverine, intermittent or upper perennial, forested, broad-leaved deciduous or emergent vegetation wetland	Sub-element of larger wildlife habitat types	**Geomorphic Setting.** Riverine. Headwater position. First order stream. Flows not continuous. Flow precludes extensive wetland development. Unvegetated reaches allow light penetration to support aquatic production. **Water Source.** Groundwater discharge and lateral surface transport from upstream. **Hydrodynamic Properties.** Unidirectional flow with properties of high gradient or middle gradient land forms.
Excavated drainage wetlands	Riverine, intermittent or upper perennial, unconsolidated bottom wetland with or without emergent vegetation	Sub-element of larger wildlife habitat types	See drainages.
Freshwater marsh	Palustrine emergent wetland, permanently or irregularly flooded	Fresh emergent wetland Lacustrine	**Geomorphic Setting**. Temporary flood storage; drainage back to stream shortly after flooding with surface water supported marshes or continuous saturation from groundwater supported marshes. Probable import and export of detritus. **Water Source**. Water supplies support vegetative complexity and habitat structure not found in uplands because of water stress in arid climate.

Table 4.10-1

Regional Wetland Habitat Types and Functional Habitat Classification Systems

Wetland Plant Community Type (Shuford and Timossi/Holland)[1]	Wetland Classification (Cowardin)[2]	Wetland Wildlife Habitat (Mayer and Laudenslayer)[3]	Physical Wetland Classification (Brinson)[4]
			Hydrodynamic Properties. Residence time of water allows long contact between water and sediment. Low suspended load allows light penetration. Good conditions for trapping sediment and altering water quality. As nutrients trap, food web support is strong. Reducing conditions favor strongly obligate wetland species.
Freshwater ponds	Impounded, palustrine, emergent wetland fringe, with unvegetated shallows	Lacustrine	**Geomorphic Setting.** Artificially impounded drainages converted to seasonal stock ponds. These features have surface inlets as well as gradual outlets in the form of leakage below the dam site. They provide temporary flood storage although most are equipped with spillways. **Water Source.** Groundwater discharge, and, during flood flows, lateral surface transport from upstream. High water tables are maintained by catchment supplies from upstream and from groundwater sources. Water supplies support vegetative complexity not found in uplands because of water stress in arid climate. **Hydrodynamic Properties.** Nearly constant water table at or near the surface. These levels are augmented during high flows with unidirectional flow from the upstream watershed.

Table 4.10-1

Regional Wetland Habitat Types and Functional Habitat Classification Systems

Wetland Plant Community Type (Shuford and Timossi/Holland)[1]	Wetland Classification (Cowardin)[2]	Wetland Wildlife Habitat (Mayer and Laudenslayer)[3]	Physical Wetland Classification (Brinson)[4]
Freshwater seeps	Palustrine, emergent wetland, intermittently flooded	Sub-element of larger wildlife habitat types	**Geomorphic Setting**. In cases where groundwater discharge occurs at the face of a slope, flows may maintain saturated conditions year-round, resulting in shallow but predictably stable water table flooding. Availability of this water source during dry periods may contribute to diversity of the landscape. **Water Source**. Resources are abundant and the environment is predictable, making conditions conducive to relatively high primary production and biomass accumulation. **Hydrodynamic Properties**. Water replacement stabilized by groundwater seepage may maintain high redox levels relative to stagnant saturated soils, thus allowing the establishment of plant species that are not restricted to strongly reducing environments.
Mixed riparian woodland	Riverine, intermittent or upper perennial, forested, broad-leaved deciduous wetland	Valley foothill riparian	**Geomorphic Setting**. Wetlands in this middle-gradient landform differ from surrounding landscape by displaying a preponderance of woody vegetation and high structural complexity. Such corridors of forest provide habitat for many songbirds and other wildlife. Active geomorphology assures interspersion of plant communities, thus contributing to beta diversity. **Water Source**. Water supply supports vegetative complexity and habitat structure in contrast to poorly developed vegetation in arid uplands. Floodplain

Table 4.10-1

Regional Wetland Habitat Types and Functional Habitat Classification Systems

Wetland Plant Community Type (Shuford and Timossi/Holland)[1]	Wetland Classification (Cowardin)[2]	Wetland Wildlife Habitat (Mayer and Laudenslayer)[3]	Physical Wetland Classification (Brinson)[4]
			topographic features are varied and complex, providing the template for interspersion of several plant communities ranging from early successional, shade-intolerant species to those occupying more stable sites. **Hydrodynamic Properties**. Interspersion of low- and high-energy environments supports complex food webs. Because they are relatively well flushed during flood events and aerated near surface, accumulation of organic matter is prevented. Consequently, they possess a high capacity to import nutrients and export toxins. (Brinson 1993)
Non-wooded riparian wetland	Riverine, intermittent or upper perennial, unconsolidated bottom wetland with or without emergent vegetation	Sub-element of larger wildlife habitat types	See drainages.

Table 4.10-1

Regional Wetland Habitat Types and Functional Habitat Classification Systems

Wetland Plant Community Type (Shuford and Timossi/Holland)[1]	Wetland Classification (Cowardin)[2]	Wetland Wildlife Habitat (Mayer and Laudenslayer)[3]	Physical Wetland Classification (Brinson)[4]
Seasonally wet vegetation wetland (including vernal pools)	Palustrine, emergent wetland, seasonally flooded	Annual grassland	**Geomorphic Setting**. Endemic species are likely in vernal pools since they are inaccessible to aquatic organisms dependent on streams. **Water Source.** Rarity of water table drawdown promotes organic matter accumulation which further retards drainage. Conditions support a diverse endemic flora and fauna. **Hydrodynamic Properties**. Frequent deficits in site-water balance result in ephemeral aquatic ecosystems because of temporary floodwater storage. Support of rare plant and aquatic communities.
Undetermined wetland type	N/A	Sub-element of larger wildlife habitat types	N/A
Willow riparian wetlands	Riverine, intermittent or upper perennial, forested, broad-leaved deciduous wetland	Valley foothill riparian	Similar to mixed riparian woodland described above, but lacking the structural diversity of the mixed woody vegetation.

Source: Harland Bartholomew & Associates, 1996

1. Community types developed after Shuford and Timossi's "Plant Communities of Marin County" (1989) and Robert Holland's "Preliminary Descriptions of the Terrestrial Natural Communities of California" (1986).
2. Cowardin et al., 1979. Classification of Wetlands and Deepwater Habitats of the U.S..
3. Mayer and Laudenslayer, 1988. A Guide to Wildlife Habitats of California.
4. Wetland function descriptions derived from the Hydrogeomorphic Classification for Wetlands (Brinson 1993).
5. Freshwater ponds are conventionally considered palustrine habitat and will be referenced throughout this section as palustrine, through the CWHR System groups lacustrine and palustrine under lacustrine.

Regional Resource Planning Efforts

Many large-scale wetlands planning efforts have been undertaken throughout Sonoma and Marin counties to conserve and restore wetlands resources. A summary of the major regional planning efforts and their guidelines for wetlands resources protection is presented in Table 4.8-4 in the Terrestrial Biological Resources Section.

Geographic Area Resource Description (Area of Indirect Impacts)

The Area of Indirect Impacts in Sonoma and Marin counties can be divided into five relatively distinct geographic areas (Santa Rosa Plain/Russian River, West County, South County, Sebastopol, and geysers) based primarily on watersheds and their associated aquatic and terrestrial biological resources. A brief discussion of the affected environment, including jurisdictional wetlands and local wetlands resource planning efforts, follows. The geographic areas are shown on Figure 4.8 - 1a, b, and c of Section 4.8, Terrestrial Biological Resources.

Santa Rosa Plain/Russian River

Watersheds

The major watersheds associated with the Santa Rosa Plain/Russian River area are those drained by the Russian River, Mark West Creek, and Santa Rosa Creek. However, other smaller perennial and intermittent creeks are also present within this geographic area.

Jurisdictional Wetlands and Other Waters of the U.S.

Seasonal wetlands occur on poorly drained soils, such as the Clear Lake soil type, and are common in the Santa Rosa Plain area. Many of these wetlands are highly disturbed through long-term exposure to heavy grazing pressure and other agricultural uses including oat and hay production.

Vernal pools are often hydrologically linked to other seasonal wetlands and are scattered throughout the Santa Rosa Plain. Human disturbances have resulted in localized degradation of this unique resource. Many endemic wildlife and plant species of vernal pools are now provided federal and state protection, including California linderiella (*Linderiella occidentalis*), California tiger salamander (*Ambystoma californiense*), dwarf downingia (*Downingia pusilla*), Sonoma sunshine (*Blennosperma bakeri*), Sebastopol meadowfoam (*Limnathes vinculans*), many-flowered navarretia (*Navarretia leucocephala* ssp. *plieantha)*, and Burke's goldfields (*Lasthenia burkei*).

many-flowered navarretia (*Navarretia leucocephala* ssp. *plieantha)*, and Burke's goldfields (*Lasthenia burkei*).

West County

The West County geographic area is defined as north of San Antonio Creek/Petaluma, south of a line between Salmon Creek and Sebastopol, and east of U.S. Highway 1 with a western limit approximately ten miles west of U.S. Highway 1 along Americano Creek (see Figure 4.8-1 (c) of the Terrestrial Biological Resources Section).

Watersheds

The main watersheds in the West County area are Americano Creek, Stemple Creek, Estero de Americano, and Estero de San Antonio. However, other smaller perennial and intermittent creeks are present within the geographical area.

Jurisdictional Wetlands and Other Waters of the U.S.

The most extensive salt marsh communities in the Area of Indirect Impacts are located at the mouths of the Estero Americano and Estero de San Antonio. Salt marshes, mudflats, perennial freshwater marshes, and salt ponds are found near the mouth of the Estero Americano (Smith 1988). The Estero de San Antonio also supports salt marshes and perennial freshwater marshes, with smaller acreage of salt ponds, mud flats, and eelgrass beds (Smith 1988). Both esteros are protected under as part of the Gulf of Farallones National Marine Sanctuary. Seeps and intermittent streams are present on the hillsides surrounding both esteros (Madrone Associates 1977). Livestock grazing has affected the wetlands present in the Esteros Americano and de San Antonio, reducing vegetative cover and degrading water quality (Smith 1988).

In contrast to the primarily saline environment of the esteros, other wetlands in the West County area are emergent freshwater systems on the floors of Coast Range valleys associated with seasonally flooded low gradient stream systems. These habitats develop in gentle swales between small ridges. Some willow riparian habitat is present in areas that have not been heavily grazed.

The Two Rock reservoir site possesses a deeply-incised ephemeral tributary drainage discharging to a perennial, intermittently impounded unnamed mainstem creek. Potential jurisdictional wetlands present at the proposed Two Rock site are narrow swales in gully bottoms, bottom-land wet meadows, broad low-gradient hillside swales, hillside freshwater seeps, and emergent marsh habitat associated

with stockponds, tributaries, and the unnamed mainstem. Waters of the U.S. at this site include high gradient ephemeral stream channels and the unnamed creek channel. Drainages and annual grassland wetlands dominated by grazed non-native grasses represent approximately half of the potential jurisdictional wetlands at this proposed reservoir site.

At the Bloomfield reservoir site, two intermittent channels converge to form a broad basin incised by a perennial, slow-moving, unnamed main creek channel. Potential jurisdictional wetlands present on the basin floor include annual grassland wetlands dominated by heavily grazed, non-native grasslands, emergent reaches of the unnamed mainstem creek, hillside freshwater seeps, and stream tributaries. The creek is dammed in several places, creating a series of stock ponds with a scattering of emergent vegetation around them. Waters of the U.S. observed at the site include incised ephemeral stream channels and the unnamed perennial mainstem creek. The majority of wetland acreage on this site consists of annual grassland wetlands or seasonally wet vegetation on the basin floor. Willow riparian vegetation is located in the upper reaches of the unnamed creek, and freshwater marsh habitat is located downstream.

The Valley Ford reservoir site supports broad annual grassland wetlands dominated by heavily grazed non-native grassland, some incised channels, and several stock ponds. Potential jurisdictional wetlands are found in the broad, flat basin floor along the main axis of the proposed reservoir site, in narrow seasonal drainages in gully bottoms, and in association with stock ponds. Waters of the U.S. observed at this site include two incised ephemeral tributary channels which flow into the unnamed perennial mainstem creek. The predominant type of wetland at the site is heavily-grazed annual grassland wetland located on the basin floor. However, large areas of freshwater marsh are associated with stock ponds, and a protected band of continuous willow riparian woodland is present along one of the tributaries to the unnamed main creek.

The Carroll Road reservoir site has two incised, high-gradient tributaries discharging to an unnamed mainstem creek channel. Potential jurisdictional wetlands include hillside freshwater seeps, annual grassland wetlands on broad, flat basin floors, wide low-gradient drainages (both types dominated by grazed non-native grasslands), and freshwater marsh areas associated with stock ponds and the deeply incised unnamed creek mainstem. Waters of the U.S. include the incised ephemeral and perennial tributaries, as well as the perennial mainstem creek.

The upper watershed of the Huntley reservoir site is characterized by freshwater seeps, annual grassland wetlands, seasonally wet vegetation in basins and swales, and high gradient drainages with overstories of eucalyptus. The unnamed main

creek channel traverses the length of the site. The upper third portion of main channel vegetation is dominated by eucalyptus. The middle section is dominated by dense mixed and willow riparian vegetation. The lower section is characterized by seasonally wet vegetation on the widened valley floor bisected by a non-wooded riparian channel.

South County

Wetlands

The main watersheds in the South County area are drained by Washington Creek, San Antonio Creek, Willow Brook Creek, Lichau Creek, Tolay Creek, Copeland Creek, and the Petaluma River, along with other perennial and intermittent creeks.

Jurisdictional Wetlands and Other Waters of the U.S.

Potential jurisdictional wetlands present in the South County area include hillside and valley freshwater seeps and willow riparian woodlands growing along deeply incised stream channels. Prominent in the Tolay Creek watershed is a large historic lakebed that was converted to agriculture at the turn of the century. Both the Tolay Extended and Tolay Confined reservoir sites are located in the Tolay Valley. Remnant patches of the lakebed remain unconverted and function as annual grassland wetland or seasonally wet grassland. Cropped lakebed has been classified as farmed wetland. Other potential jurisdictional wetlands found in the Tolay watershed include emergent freshwater marsh areas in linear drainages, the mainstem of Tolay Creek, hillside freshwater seeps, narrow strips of freshwater marsh along the shorelines of stock ponds and low streambanks, and swales in gully bottoms. Waters of the U.S. that are associated with this watershed include the perennial mainstem of Tolay Creek and some of its ephemeral drainages.

At the Adobe Road reservoir site, deeply-incised ephemeral tributaries feed a well-scoured, gravel-bottomed main channel. Under dry season conditions, multiple pools of standing water exist in the main channel. Potential jurisdictional wetlands are predominantly in narrow gully bottom swales. Other observed potential jurisdictional wetlands at this proposed reservoir site include a freshwater marsh at the periphery of a stock pond (located at the drainage head), and several hillside freshwater seeps. Waters of the U.S. present at the Adobe Road site include many ephemeral tributary channels and the unnamed ephemeral creek mainstem.

The Lakeville Hillside reservoir site contains two deeply-incised ephemeral tributaries discharging to an unnamed mainstem creek. Potential jurisdictional

wetlands are present in narrow gully-bottom swales and include annual grassland wetlands dominated by non-native grassland associated with the mainstem, hillside freshwater seeps, and some freshwater marshes associated with ponded segments of the unnamed mainstem creek. Waters of the U.S. at this site include steep-gradient ephemeral tributaries and the low-gradient, intermittent creek mainstem.

The Sears Point reservoir site possesses deeply-incised ephemeral tributaries discharging to the moderate to deeply incised Tolay Creek. Potential jurisdictional wetlands are present primarily in the mainstem, adjacent stream terraces, and tributaries to Tolay Creek. Channels are bordered by forested riparian woodlands, especially on stream terraces. These riparian woodlands are composed of a mixture of willows, cottonwood, and valley oak, with a sparse herbaceous understory. Potential jurisdictional wetlands include portions of drainages located in gully bottoms, freshwater seeps, and freshwater marsh associated with stock ponds adjacent to Tolay Creek on the basin floor. Some freshwater marsh habitat is present at the Sears Point site but is limited to narrow strips along low stream banks and small islands on sandbars at the confluence of Tolay Creek and its tributaries.

The bay flats region consists largely of diked and levied salt marsh areas that were converted to farmlands prior to 1985. Rye grass (*Lolium* spp.) is the most commonly farmed crop in lowland areas (-5 to +5 feet above mean sea level), while vineyards have been established at higher elevations (>5 ft above mean sea level). In addition, salt marsh habitat occurs along the lower Petaluma River where it enters San Pablo Bay in Marin County. Emergent wetlands bordering the numerous canals are a significant component of potential jurisdictional wetlands within the bay flats region. The emergent wetlands range in salinity from brackish in the lower regions of the watershed to fresh in the upper portions. Salinity regimes in this wetland type are affected by various factors including seepage of groundwater from the surface aquifer and mixing with more saline areas downgradient of the seeps. The fluctuations in salinity and availability of perennial water encourage a diverse plant community in the freshwater emergent marshes in this area.

Sebastopol

Watersheds

There are two major watersheds within the Sebastopol area. One is drained by Green Valley Creek and Atascadero Creek, and the other is drained by Mark West Creek and the Laguna de Santa Rosa. The Laguna de Santa Rosa, the floodplain

for Mark West Creek, is described above under the Santa Rosa Plain/Russian River geographic area.

Jurisdictional Wetlands and Other Waters of the U.S.

The majority of wetland types in the Sebastopol area are wetlands converted to apple orchards and oat hay farmlands. This area has been heavily impacted by development and few undisturbed wetland areas remain. Some riparian forested habitat exists along deeply incised stream channels. The Santa Rosa Plain Vernal Pool Ecosystem Preservation Plan (CH2M Hill 1995) identifies high quality vernal pools east of Sebastopol and west of Santa Rosa.

Geysers

Watersheds

The principal drainage in the geysers area is Big Sulphur Creek which is a tributary to the Russian River. Several smaller tributaries are also present within the geysers area including Anna Belcher Creek, Little Sulphur Creek, Cobb Creek, Squaw Creek, Hurley Creek, Deer Creek, Sausal Creek, Hoot Owl Creek, Maacama Creek, Franz Creek, Brooks Creek, and Pool Creek.

Jurisdictional Wetlands and Other Waters of the U.S.

At lower elevations, seasonal flooding results in potential jurisdictional wetlands adjacent to a variety of perennial and intermittent streams within the geysers geographic area. At higher elevations, flooding diminishes, stream channels are incised, and potential jurisdictional wetland habitat adjacent to streams decreases. At higher elevations in a few areas, unique wet meadow habitats occur where groundwater breaks out of slope areas and ponds on small (15 to 30 feet wide) swale areas. These meadows and seeps, often on serpentinite soils and surrounded by Ponderosa pines are highly diverse and harbor several rare plant species. At the highest elevations, streams are ephemeral, and little wetland vegetation is present along them.

EVALUATION CRITERIA WITH POINTS OF SIGNIFICANCE

The CEQA Guidelines (1994) state that effects on the environment that conflict with adopted environmental plans or goals are normally regarded as significant. A "no net loss of wetland acreage or value" policy is established within both the state and federal executive branches (California Wetlands Conservation Policy 1993). For the purposes of

this document, any unmitigated destruction of wetlands or other waters of the U.S. (either in fill or areal extent of destruction) is considered significant.

Ditching, draining, or other activities which could alter the characteristic physical, chemical, biological or public interest values (as defined by 40 CFR 230 Subparts C-F) associated with wetlands and other waters of the U.S. are considered impacts under Corps authority and are evaluated in other appropriate sections.

Table 4.10-2

Evaluation Criterion with Point of Significance - Jurisdictional Wetlands Resources

Evaluation Criterion	As Measured by	Point of Significance	Justification
1. Will the Project destroy wetlands or other waters of the U.S.?	Acreage of permanent discharge to or placement of fill in potential jurisdictional wetlands or other waters of the U.S.	Greater than 0 acre	Clean Water Act, 40 CFR 230 Section 404(b)(1) Guidelines, Corps, EPA, and State of California no net loss policies.

Source: Harland Bartholomew & Associates, Inc., 1996

METHODOLOGY

Wetland determinations were conducted on Project component sites utilizing Corps recommended on-site and off-site methods. Wetland boundaries were estimated on the appropriate base map. The following attributes were estimated during the GIS analysis for each wetland:

- Areal extent (acreage);
- Wildlife habitat; and
- Dominant vegetative community.

The dominant vegetative community type was determined by overlaying the wetlands mapping with the vegetative community mapping (Harland Bartholomew & Associates, Inc. 1996b-f). This methodology resulted in upland vegetative community assignment to small fragments of wetlands where the boundaries of the vegetative mapping and the wetland mapping were slightly inconsistent. As a result, portions of some wetlands may be attributed with an upland vegetative community (i.e. oak woodland, eucalyptus). Formal jurisdictional delineations of the wetland boundaries on all components of the

selected Project will be conducted during Project permitting. All discrepancies in vegetative community assignments will be corrected at that time.

Storage Reservoirs

The survey area included all lands within each reservoir storage site and within 500 feet of proposed impoundment shorelines. Prior to field surveys for wetlands and other waters of the U.S., the following information was evaluated for the ten reservoir sites:

- 1" = 500' aerial photos of the proposed reservoir sites overlain with proposed reservoir/shoreline boundaries (May 1994);
- National Wetland Inventory maps prepared by the U.S. Fish and Wildlife Service;
- U.S. Geological Service (USGS) quadrangle maps of the Project site and surrounding region;
- Soil Conservation Service (SCS) Soil Survey of Sonoma County (1972);
- SCS Soil Survey of Marin County (1985); and
- Jurisdictional Wetland Delineation for Portions of the Stemple and Americano Creek Basins and the Tolay Valley, prepared by North State Resources and Golden Bear Biological Studies for CH2M Hill (CH2M Hill et. al. 1990).

Areas that appeared to support potential jurisdictional wetlands and other waters of the U.S. were identified on USGS and SCS maps and aerial photos in the office before field work began. Field determinations were conducted during July, August, and September of 1994 and February, March, April, and May of 1995. Some potential jurisdictional wetlands were revisited in the spring of 1995 to confirm vegetation determinations and to record hydrologic indicators which were not readily observable during dry season surveys in the summer of 1994. Determinations at each data point were made following the 1987 Corps of Engineers Wetland Delineation Manual (Environmental Laboratory 1987) on the basis of three mandatory wetland criteria (hydrophytic vegetation, hydric soils, and wetland hydrology). However, the mapped boundaries of wetlands were based primarily on an analysis of aerial photographs and field observations of vegetation types.

All potential jurisdictional wetlands and other waters of the U.S. larger than 0.10 acre were mapped and many other smaller seeps and isolated wetlands were included. The approximate acreage for each wetland community type mapped on each proposed reservoir site was rounded off to the nearest acre. Potential jurisdictional wetland boundaries were recorded on 1" = 500' scale aerial photos. Slight variations in shade and texture that were visible on the aerial photos were correlated with field observations to confirm wetland boundaries. This information was then transferred to 1" = 500' scale contour base maps of each site, the information was compared with vegetation community mapping, and the information was incorporated into the Project GIS data base

for analysis (*Biological Resource Volume 4A - E,* Harland Bartholomew & Associates, Inc. 1996b-f).

A summary and checklist of all sites visited and Routine On-Site Determination Method Data Forms are included in the *Wetland Determination Report for Proposed Reservoir Sites* (Parsons Engineering Science, Inc. 1996c).

Pump Stations

Planning level wetland determinations were completed for pump stations using off-site methods and drive-by surveys. A few pump stations were accessed during early surveys of the reservoir storage sites and agricultural irrigation areas, and this information was incorporated into the Project GIS data base. Off-site surveys used 1"=500' June 1990 black and white aerial photographs, USGS topographic maps, 1972 Sonoma County Soil Survey Report, Project facility maps overlayed with topographic lines at 1" = 1000' scale, and previous studies of the area. For areas for which it was available, off-site mapping performed as part of the wetland determinations of agricultural irrigation areas was also used for the pump station determinations.

Pipelines

Planning level wetland determinations were performed along proposed transmission and distribution pipelines between April 1995 and January 1996 by means of drive-by surveys and, wherever possible, wetland determinations following the 1987 Corps Manual. Areas evaluated included well defined channels, swales and depressions generally larger than 5 feet wide (referred to in this discussion as "stream crossings") which crossed or ran parallel to the surveyed roadways. Alignments on private property outside rights-of-way were not surveyed. Stream crossings in urban areas such as Santa Rosa or along existing pipeline routes were not surveyed for potential jurisdictional wetlands or other waters of the U.S., but were surveyed for aquatic habitat (Merritt Smith Consulting 1996c). Small pipelines that would convey irrigation water from distribution lines to individual irrigation systems have not been designed and therefore impacts could not be evaluated. As stated in the Irrigation Management Guidelines, detailed site-specific Irrigation Conservation and Management Programs will be prepared for each parcel proposed for irrigation with reclaimed water (Questa Engineering Corporation 1996). Additional site studies will be required in order to ensure avoidance or minimization of potential impacts from the installation of these pipelines.

On-site determinations were conducted solely along pipeline alignments in roadways with public rights-of-ways within 30 feet of the roadway centerline, often at bridge or culvert crossings. Stream crossing locations and attributes were recorded on 1" = 500' June 1990 aerial photos and Project facility maps that included topographic contours.

Isolated wetlands within the roadway right-of-way were noted if a prominent structure, such as a 36-inch or larger corrugated metal pipe, crossed the roadway, if evidence of prolonged surface water ponding was present, or if sensitive wetland plant communities such as vernal pools or freshwater marsh were observed. Small, isolated areas of seasonally wet vegetation, freshwater seeps and annual grassland wetlands within the right-of-way were not included in the assessment because direct impacts would be avoided through implementation of elements of design practices provided in the Project description.

Field surveys for pipelines were not completed on private property or cross-country alignments. Cross country alignments would require an approximately 60-foot wide construction disturbance corridor. Pipeline alignments have been located within existing dirt roads wherever feasible. These pipeline segments were evaluated using aerial photo interpretation, mapping generated during reservoir and agricultural irrigation area surveys, and other reference information described in the Storage Reservoirs methodology. See *Wetland Determination and Mitigation for Pipeline Alignments* for more detailed methodologies and units (Parsons Engineering Science, Inc. 1996b).

Agricultural Irrigation Areas

The extent of natural wetlands present in the irrigation areas was determined initially by analyzing existing data (listed under Storage Reservoirs) to develop preliminary wetlands mapping and irrigation suitability for parcels to be irrigated. Then, planning level wetland determinations and irrigation suitability mapping were performed on accessible properties, and off-site determinations were completed on inaccessible properties (the majority of the area involved).

Planning level wetland determinations were performed from July to September 1994; from November 1994 to March 1995; and from May to August 1995. These determinations were performed using similar methods, but at lower intensities and resolution than the determinations completed for the reservoir sites. Jurisdictional delineations will be performed for all potential wetlands prior to implementing irrigation on each parcel.

The planning level determinations for agricultural irrigation areas were mapped on June 1990 aerial photographs (1" = 500') and transferred to topographic maps (1" = 1,000'). The approximated acreages for wetland types mapped for each proposed irrigation area were rounded to the nearest acre. See *Agricultural Irrigation Areas Wetlands Determination* Technical Memorandum for detailed methodologies (Parsons Engineering Science, Inc. 1996a).

Geysers Steamfield

Stream crossings were documented in *Aquatic Habitat Survey Results* (Merritt Smith Consulting 1996b), *Aquatic Life Survey Results* (Merritt Smith Consulting 1996d), and *Aquatic Biological Resources Impacts Analysis Report* (Merritt Smith Consulting 1996e).

Discharge

The site of the Russian River outfall structure was surveyed for potential jurisdictional wetlands and waters of the U.S. using off-site methods. Off-site surveys were completed by reviewing 1" = 500' June 1990, black and white aerial photographs, USGS topographic maps, 1972 Sonoma County Soil Survey Report, and Project facility maps overlayed with topographic lines at 1" = 1000' scale.

ENVIRONMENTAL CONSEQUENCES (IMPACTS) AND RECOMMENDED MITIGATION

No Action (No Project) Alternative

Impact: **10.1.1. Will the No Action Alternative destroy wetlands or other waters of the U.S.?**

Analysis: *No Impact; Alternative 1.*

The No Action Alternative involves no additional construction. Continued discharge of reclaimed water to the Laguna will not result in the destruction of wetlands or other waters of the U.S.

Mitigation: No mitigation is needed.

Headworks Expansion Component

Impact: **10.2.1. Will the headworks expansion component destroy wetlands or other waters of the U.S.?**

Analysis: *No Impact; All Alternatives.*

The headworks expansion replaces the existing pumps, located within a building, with six new higher-capacity pumps. There will be no impact associated with permanent discharge or placement of fill in wetlands or other waters of the U.S.

Alternative 1 does not have a headworks expansion component.

Mitigation : No mitigation is needed.

Urban Irrigation Component

Impact: **10.3.1. Will the urban irrigation component destroy wetlands or other waters of the U.S.?**

Analysis: *No Impact; All Alternatives.*

The acreage and rate of application of irrigation water at the urban irrigation sites will not change. The only change will be the source of the irrigation water. Currently, these sites are supplied with water from wells and City water. The Project alternatives will provide for the use of reclaimed water. Since these are developed and landscaped properties, and both the rate of application and the area irrigated will not change as a result of this Project, there will be no impact associated with the permanent discharge or placement of fill in wetlands or other waters of the U.S.

Alternatives 1, 4, and 5 do not have an urban irrigation component.

Mitigation: No mitigation is needed.

Pipeline Component

Table 4.10-3

Jurisdictional Wetlands and Waters of the U.S. Component Impacts - Pipelines

Evaluation Criteria	Point of Significance	Impact (acres)	Type of Impact[1]	Level of Significance[2]
10.4.1. Will the Project destroy wetlands or other waters of the U.S.?	Greater than 0 acre of permanent discharge or placement of fill			
• Alt 2A		9.4	C	⊙
• Alt 2B		8.2	C	⊙
• Alt 2C		9.6	C	⊙
• Alt 2D		8.4	C	⊙
• Alt 3A		14.8	C	⊙
• Alt 3B		16.3	C	⊙
• Alt 3C		15.8	C	⊙
• Alt 3D		14.3	C	⊙
• Alt 3E		14.5	C	⊙
• Alt 4		3.1	C	⊙
• Alt 5A		.002	C	⊙
• Alt 5B		--	C	--
• All alternatives			O&M	═

Source: Harland Bartholomew & Associates, Inc. 1996

1. Type of Impact
   - C Construction
   - O&M Operation & Maintenance
2. Level of Significance
   - ⊙ Significant impact before mitigation; less than significant impact after mitigation
   - ═ No Impact
   - -- Not applicable

Impact: 10.4.1. Will the pipeline component destroy wetlands and other waters of the U.S.?

Analysis: ***Construction***

Significant; Alternatives 2, 3, 4, and 5A.

Though impacts to jurisdictional waters will be minimized through construction practices outlined in Section 2.2, Measures Included in the Project, impacts will still occur.

Under Measure 2.2.5, Avoid Sensitive Biological Resources, all perennial streams and tributaries are to be avoided by employing bore and jack construction techniques. It is assumed that no topographic constraints to the use of this technique exist along any of the pipeline alignments. Acreage of wetlands and other waters of the U.S. which will be avoided by using bore and jack construction at stream crossings, is provided in Table 4.10-4.

Table 4.10-4

Jurisdictional Waters Impacts Avoided through Bore and Jack Construction

Subalternative	Acres Avoided
Alternative 2A	0.2
Alternative 2B	0.2
Alternative 2C	0.2
Alternative 2D	0.2
Alternative 3A	1.7
Alternative 3B	1.6
Alternative 3C	1.7
Alternative 3D	1.7
Alternative 4	0.2
Alternative 5A	0.1
Alternative 5B	--

Source: Harland Bartholomew and Associates, Inc. 1996

Table 4.10-3 provides acreage of potential wetlands and waters temporarily impacted by pipeline construction through the open trench construction method and not bore and jack. To avoid impacts to aquatic habitat and aquatic life, these small segments of seasonal and ephemeral tributaries will be trenched and backfilled during the dry season (May 15 to October 15). Temporary loss of biotic values could occur during construction and continue through the period of habitat re-establishment. Wetland fills subject to Section 404 jurisdiction would result from backfill and from incidental sidecast from excavation. This acreage was determined using an estimated average disturbance width of 20 feet. Wetlands and other waters of the U.S. impacted are of variable habitat quality.

Measure 2.2.8, Revegetate Temporarily Disturbed Sites, adopted as part of the Project, requires a Revegetation Program that will revegetate all sites disturbed or scarred by construction. Additionally, Measure 2.2.9, Retain Stripped Topsoil, adopted as part of the Project, requires that topsoil removed during construction be stored on site (protected) until it can be placed as final grade in its original location.

No Impact; Alternatives 1 and 5B.

These alternatives do not have a pipeline component.

Operation and Maintenance

No Impact; All Alternatives.

Pipe rupture in aquatic habitat is not expected to result in a fill of wetlands.

No Impact/ Alternatives 1 and 5B.

These alternatives do not have a pipeline component.

Mitigation: *Alternatives 2, 3, 4, and 5A.*

2.3.10. Limit Construction Disturbance.

Alternatives 1 and 5B. No mitigation is needed.

After Mitigation: *Less than Significant; Alternatives 2, 3, 4, and 5A.*

Implementation of this measure in conjunction with the Measures Included in the Project will restore areas temporarily disturbed by construction actions.

Storage Reservoir Component

Table 4.10-5

Jurisdictional Wetlands Resources Impacts - Storage Reservoirs

Evaluation Criterion	Point of Significance	Impact (acres)	Type of Impact[1]	Level of Significance[2]
10.5.1. Will the Project destroy wetlands or other waters of the U.S.?	Greater than 0 acre of permanent discharge or placement of fill			
• Tolay Extended		248	P	⊙
• Adobe Road		30	P	⊙
• Tolay Confined		87	P	⊙
• Lakeville Hillside		24	P	⊙
• Sears Point		53	P	⊙
• Two Rock		64	P	⊙
• Bloomfield		57	P	⊙
• Carroll Road		69	P	⊙
• Valley Ford		102	P	⊙
• Huntley		48	P	⊙

Source: Harland Bartholomew & Associates, Inc. 1996

Notes:

1. Type of Impact
   P Permanent
2. Level of Significance Codes
   ⊙ Significant impact before mitigation; less than significant impact after mitigation

Impact: **10.5.1. Will the storage reservoir component destroy wetlands or other waters of the U.S.?**

Analysis: *Significant; Alternatives 2 and 3.*

Storage reservoirs and associated facilities (including dams, access roads, pump stations, and diversion channels) will result in the loss of potential jurisdictional wetland and other waters of the U.S. (including farmed wetlands) for each reservoir site. For all reservoir sites, both the direct fill of jurisdictional waters (as a consequence of reservoir construction) and inundation with reclaimed water will result in significant impacts to this wetlands resource. The affected acreage for each wetland type is provided in Table 4.10-6. See Figures 4.10-1 through 4.10-10 for the distribution of wetlands on storage reservoir sites.

Alteration of wetlands downstream of the dams due to dewatering is described in Section 4.9, Aquatic Biological Resources.

No Impact; Alternatives 1, 4, and 5.

These alternatives do not have a storage reservoir component.

Mitigation: *Alternatives 2 and 3.*

2.3.11 Sensitive Resource Conservation Program.

Alternatives 1, 4, and 5. No mitigation is needed.

After Mitigation: *Less than Significant; Alternatives 2 and 3.*

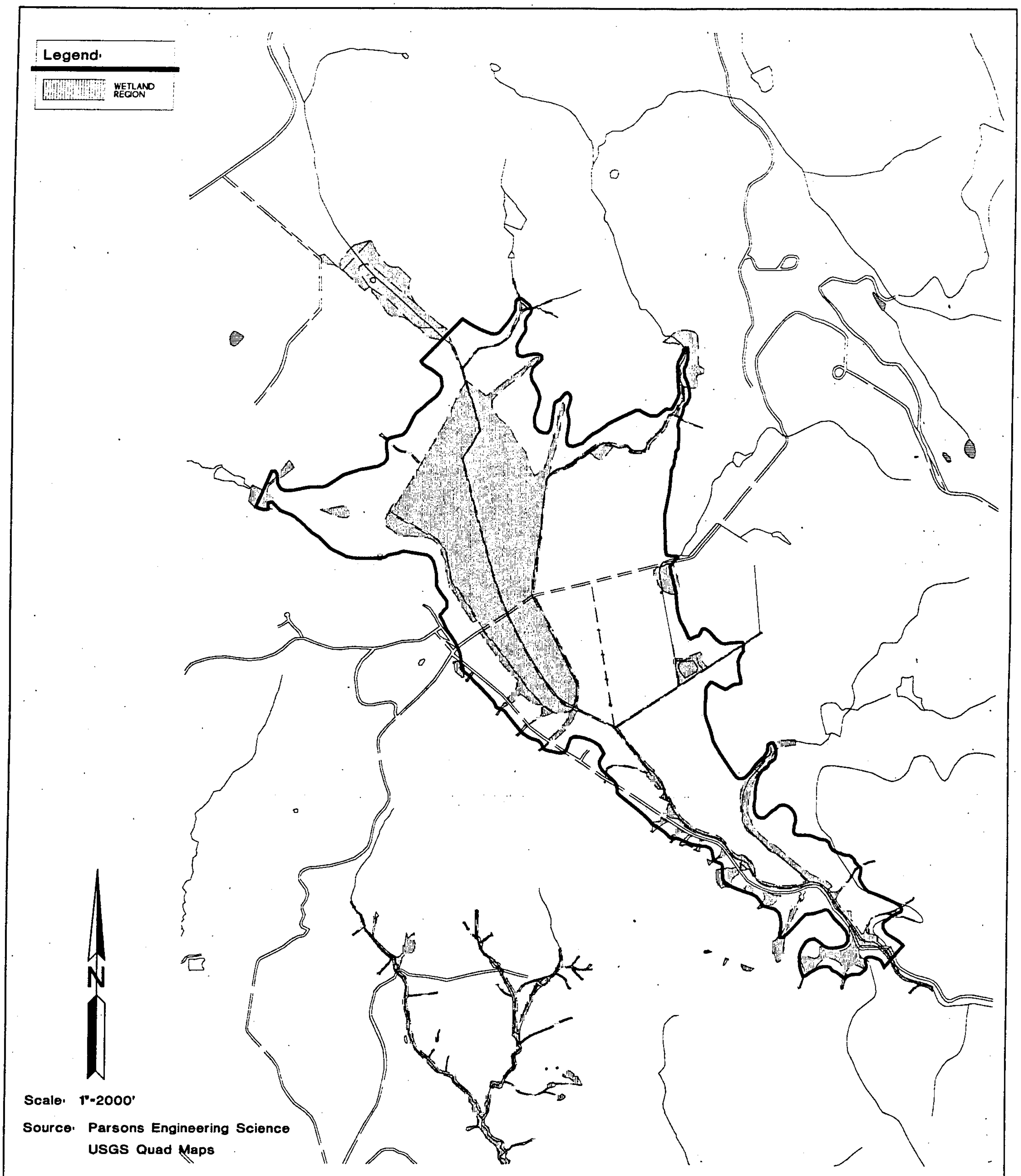
Implementation of Measure 2.3.11 Sensitive Resource Conservation Program, will compensate for loss of wetlands acreage and function through creation of new wetlands, and restoration and preservation of degraded wetlands.

Table 4.10-6

Acreages of Wetland Types Observed at Each Reservoir Site

Wetland Type	Tolay Extended	Adobe Road	Tolay Confined	Lakeville Hillside	Sears Point	Two Rock	Bloomfield	Carroll Road	Valley Ford	Huntley
Annual Grassland Wetland	37	10	22	5	26	24	40	44	49	29
Undetermined vegetation type	< 1	1	< 1	3	<2	2	2	4	<1	2
Drainage	6	0	3	< 1	1	< 1	0	< 1	3	0
Excavated Drainage	6	0	4	0	0	0	0	0	0	0
Freshwater Marsh	0	0	0	0	0	< 1	0	0	0	0
Freshwater Pond	10	2	2	< 1	0	7	1	2	3	1
Freshwater Seep	< 1	1	< 1	<1	< 1	16	0	< 1	2	2
Mixed Riparian Woodland	3	13	3	0	10	5	< 1	0	0	1
Native Grassland Wetlands	4	0	4	<1	0	0	0	<1	0	0
Non-wooded Riparian	13	2	13	6	5	2	10	1	3	3
Seasonally Wet Vegetation	14	0	1	0	1	1	0	0	35	8
Willow Riparian	2	0	2	6	7	5	4	15	6	2
Subtotal	96	30	55	24	53	64	57	69	102	48
Cropland (Farmed Wetland)	152	0	32	0	0	0	0	0	0	0
Total	248	30	87	24	53	64	57	69	102	48

Source: Harland Bartholomew & Associates, Inc., 1996



HARLAND BARTHOLOMEW and ASSOCIATES, INC.

A UNIT OF PARSONS INFRASTRUCTURE and TECHNOLOGY GROUP INC.

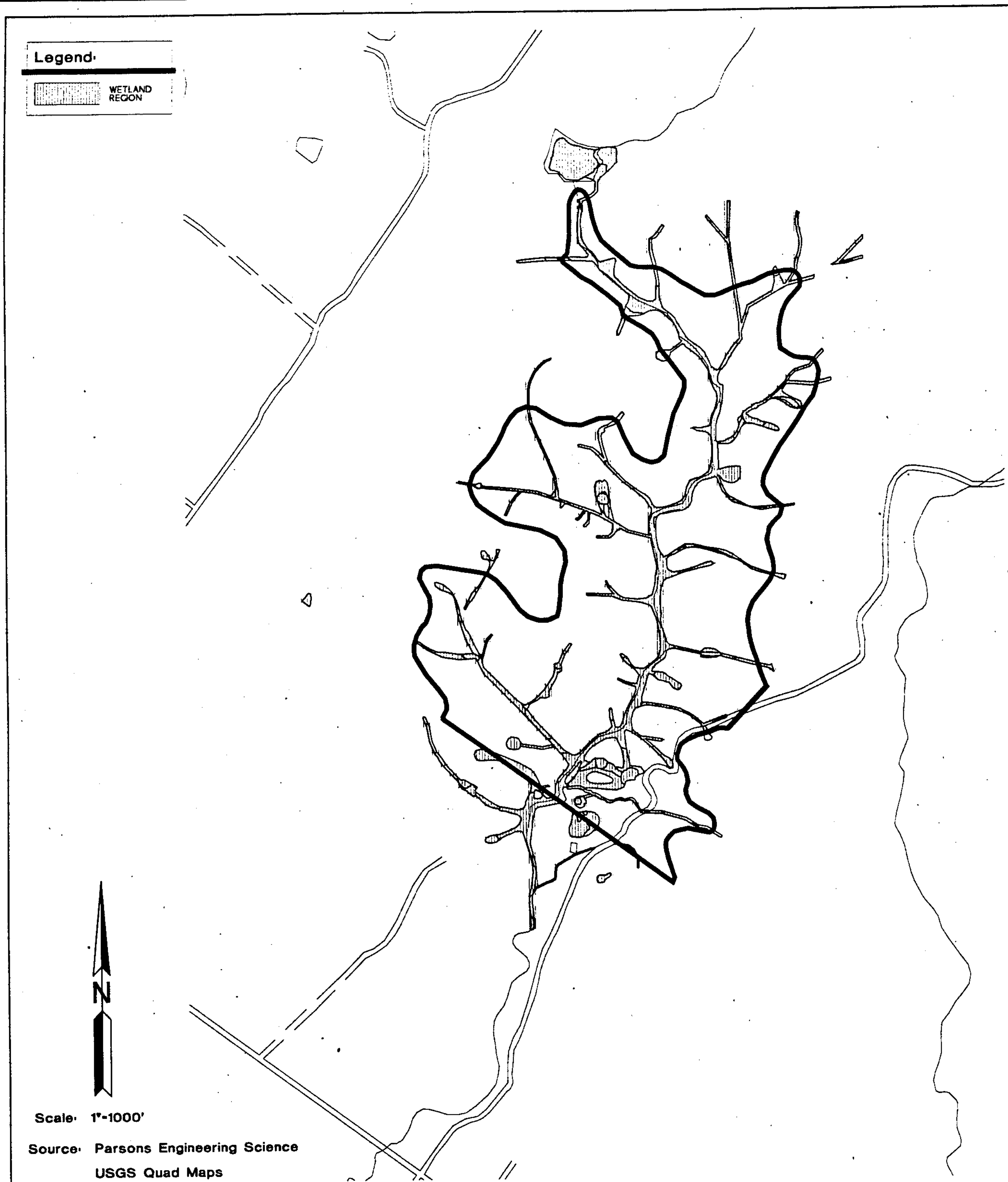
PARSONS

Santa Rosa

Subregional Long-Term Wastewater Project

ESTIMATED JURISDICTIONAL WATERS.
TOLAY EXTENDED RESERVOIR

Figure 4.10-1

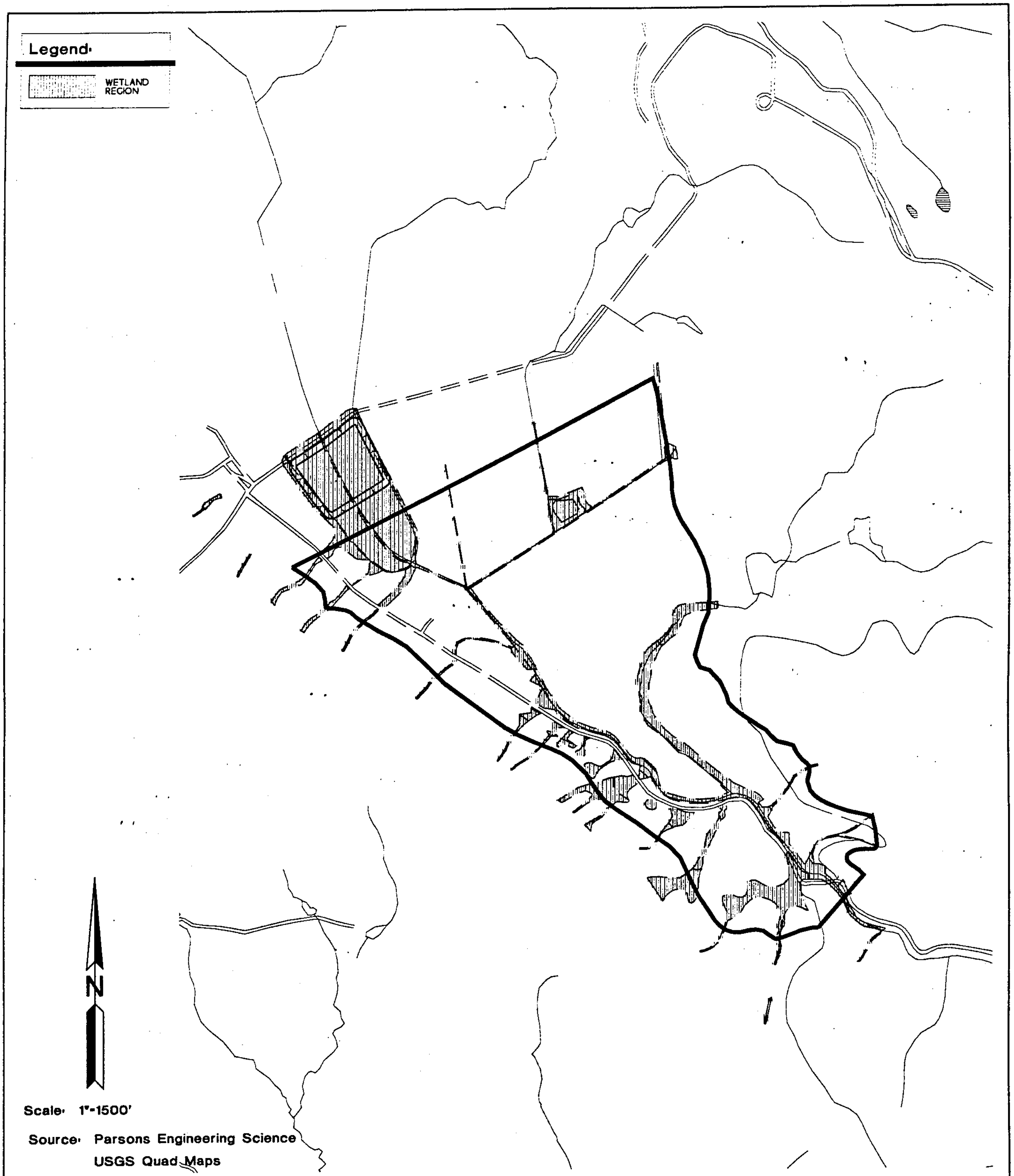


HARLAND BARTHOLOMEW and ASSOCIATES, INC.
A UNIT OF PARSONS INFRASTRUCTURE and TECHNOLOGY GROUP INC.
PARSONS

Santa Rosa
Subregional Long-Term Wastewater Project

ESTIMATED JURISDICTIONAL WATERS ADOBE ROAD RESERVOIR

Figure 4.10-2



HARLAND BARTHOLOMEW and ASSOCIATES, INC.

A UNIT OF PARSONS INFRASTRUCTURE and TECHNOLOGY GROUP INC.

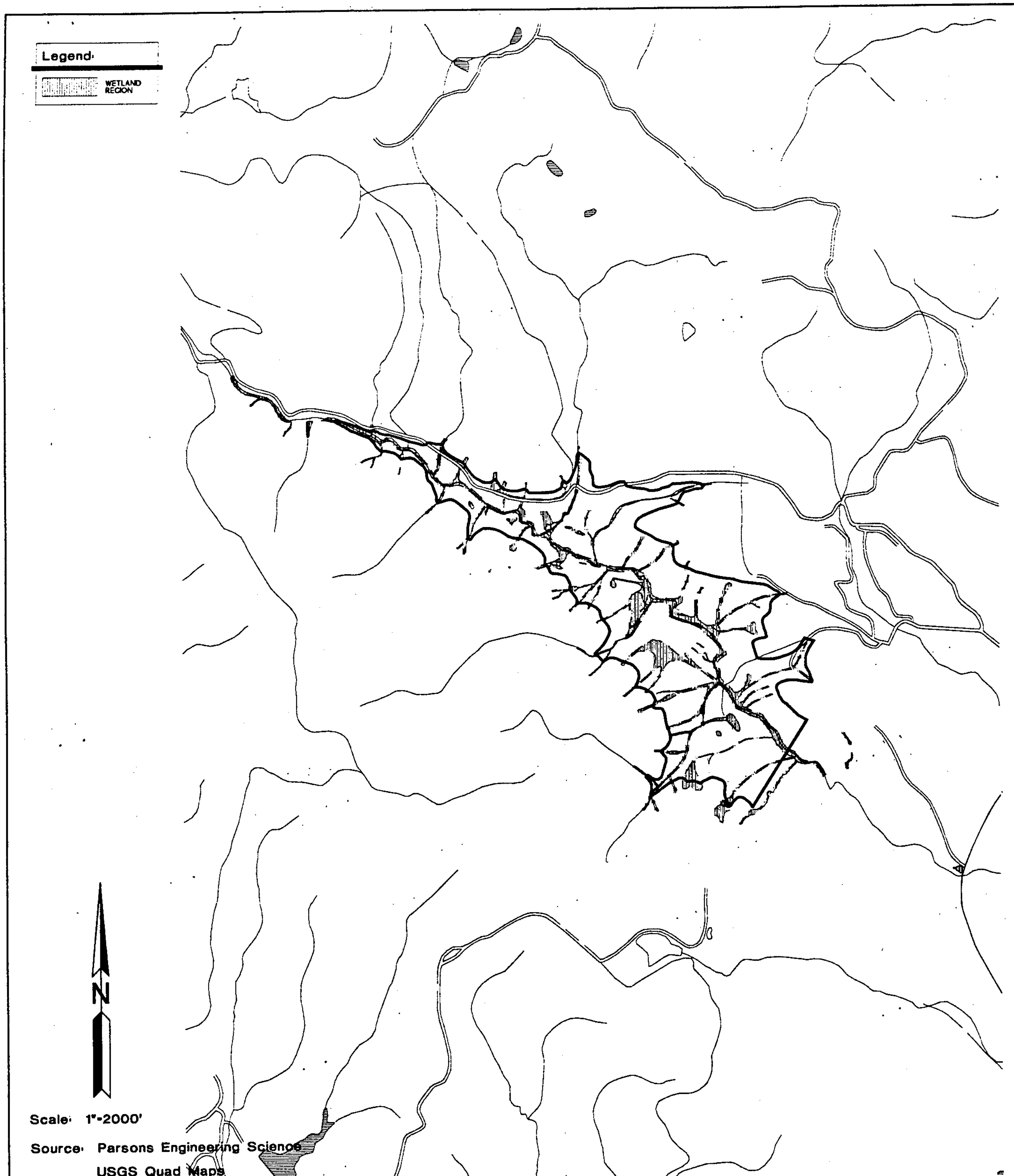
PARSONS

Santa Rosa

Subregional Long-Term Wastewater Project

ESTIMATED JURISDICTIONAL WATERS
TOLAY CONFINED RESERVOIR

Figure 4.10-3



HARLAND BARTHOLOMEW and ASSOCIATES, INC.

A UNIT OF PARSONS INFRASTRUCTURE and TECHNOLOGY GROUP INC.

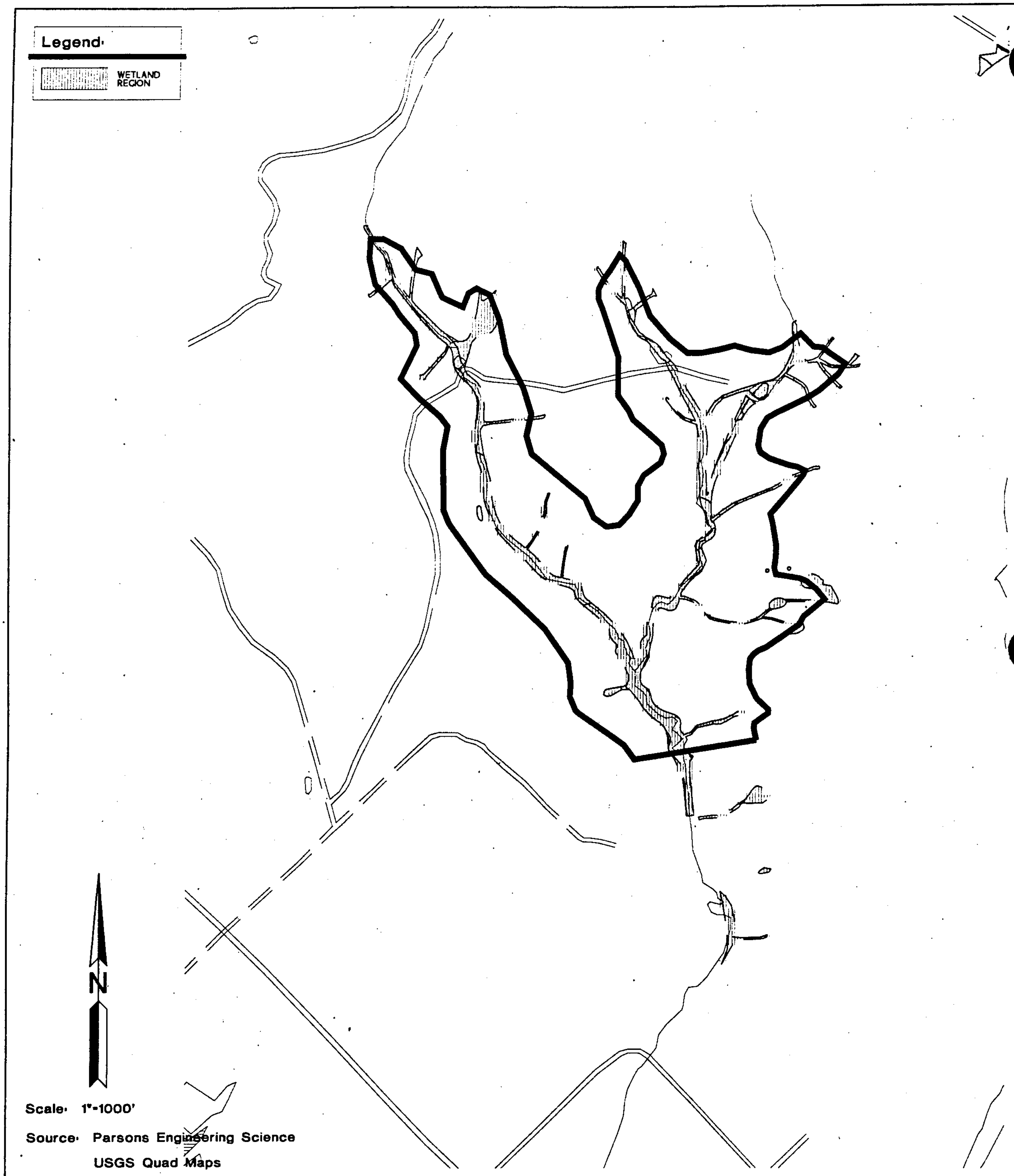
PARSONS

Santa Rosa

Subregional Long-Term Wastewater Project

ESTIMATED JURISDICTIONAL WATERS SEARS POINT RESERVOIR

Figure 4.10-4

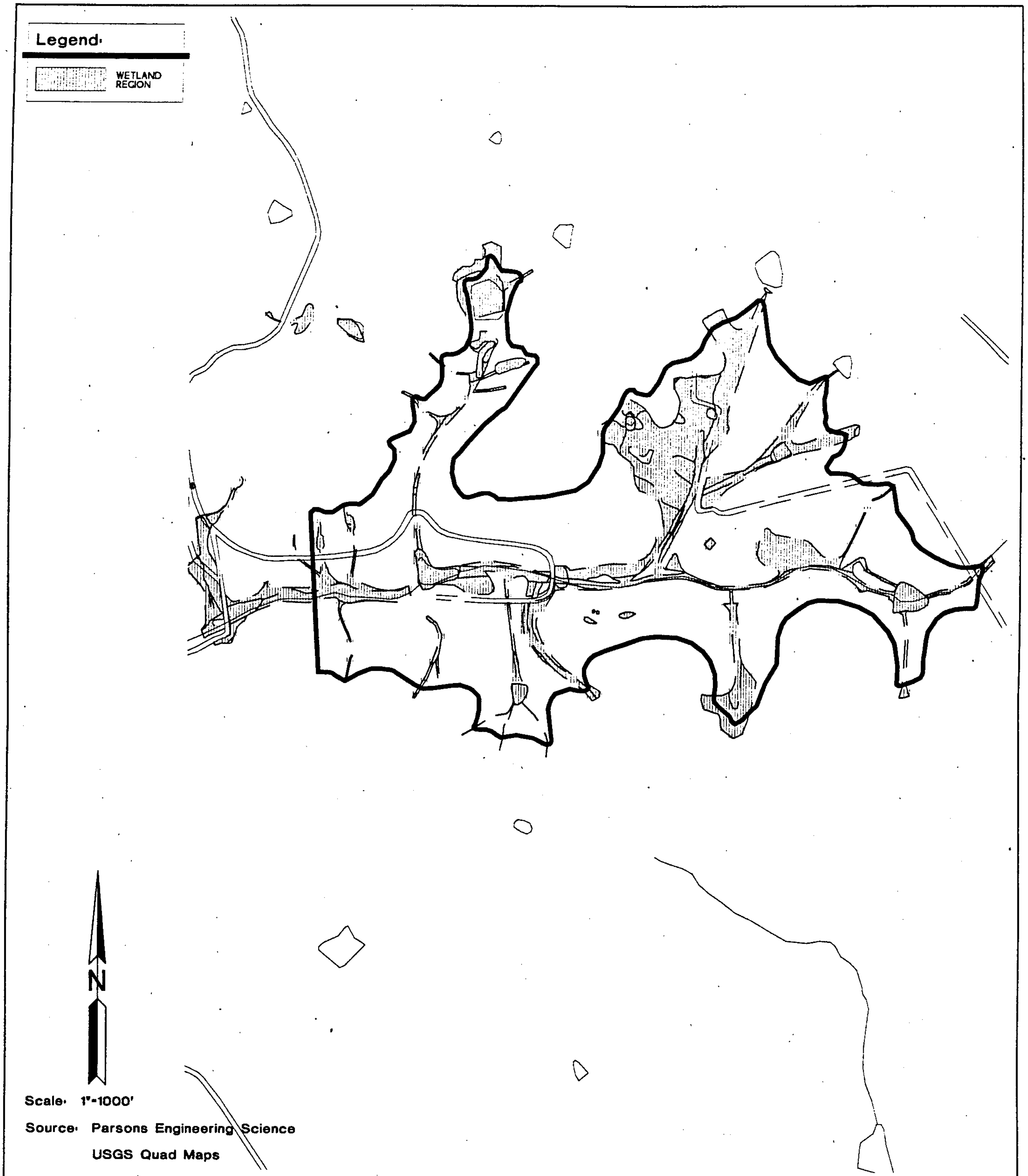


HARLAND BARTHOLOMEW and ASSOCIATES, INC.
A UNIT OF PARSONS INFRASTRUCTURE and TECHNOLOGY GROUP INC.
PARSONS

Santa Rosa
Subregional Long-Term Wastewater Project

ESTIMATED JURISDICTIONAL WATERS LAKEVILLE HILLSIDE RESERVOIR

Figure 4.10-5



HARLAND BARTHOLOMEW and ASSOCIATES, INC.

A UNIT OF PARSONS INFRASTRUCTURE and TECHNOLOGY GROUP INC.

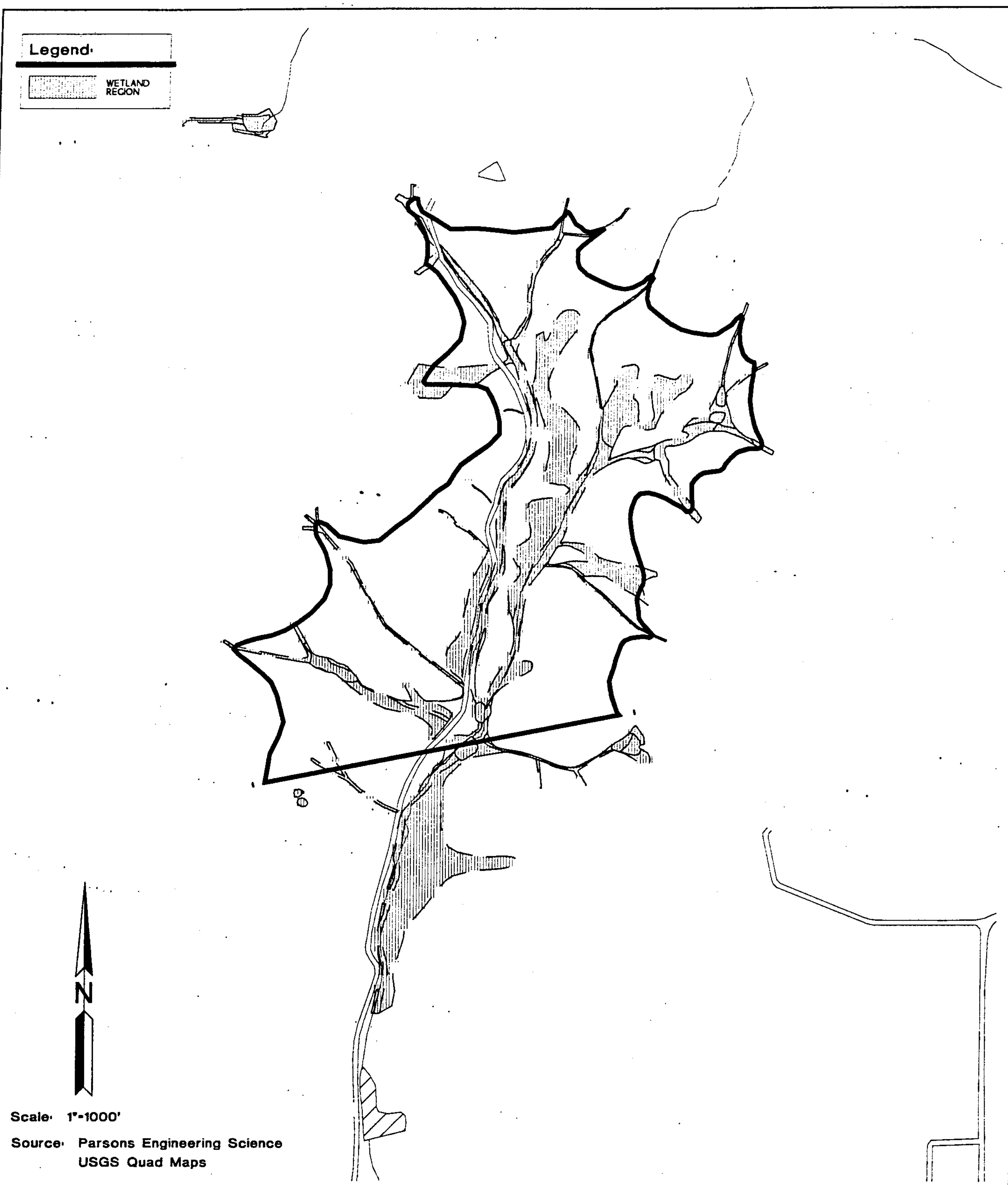
PARSONS

Santa Rosa

Subregional Long-Term Wastewater Project

ESTIMATED JURISDICTIONAL WATERS TWO ROCK RESERVOIR

Figure 4.10-6



Scale: 1"=1000'

Source: Parsons Engineering Science
USGS Quad Maps

HARLAND BARTHOLOMEW and ASSOCIATES, INC.

A UNIT OF PARSONS INFRASTRUCTURE and TECHNOLOGY GROUP INC.

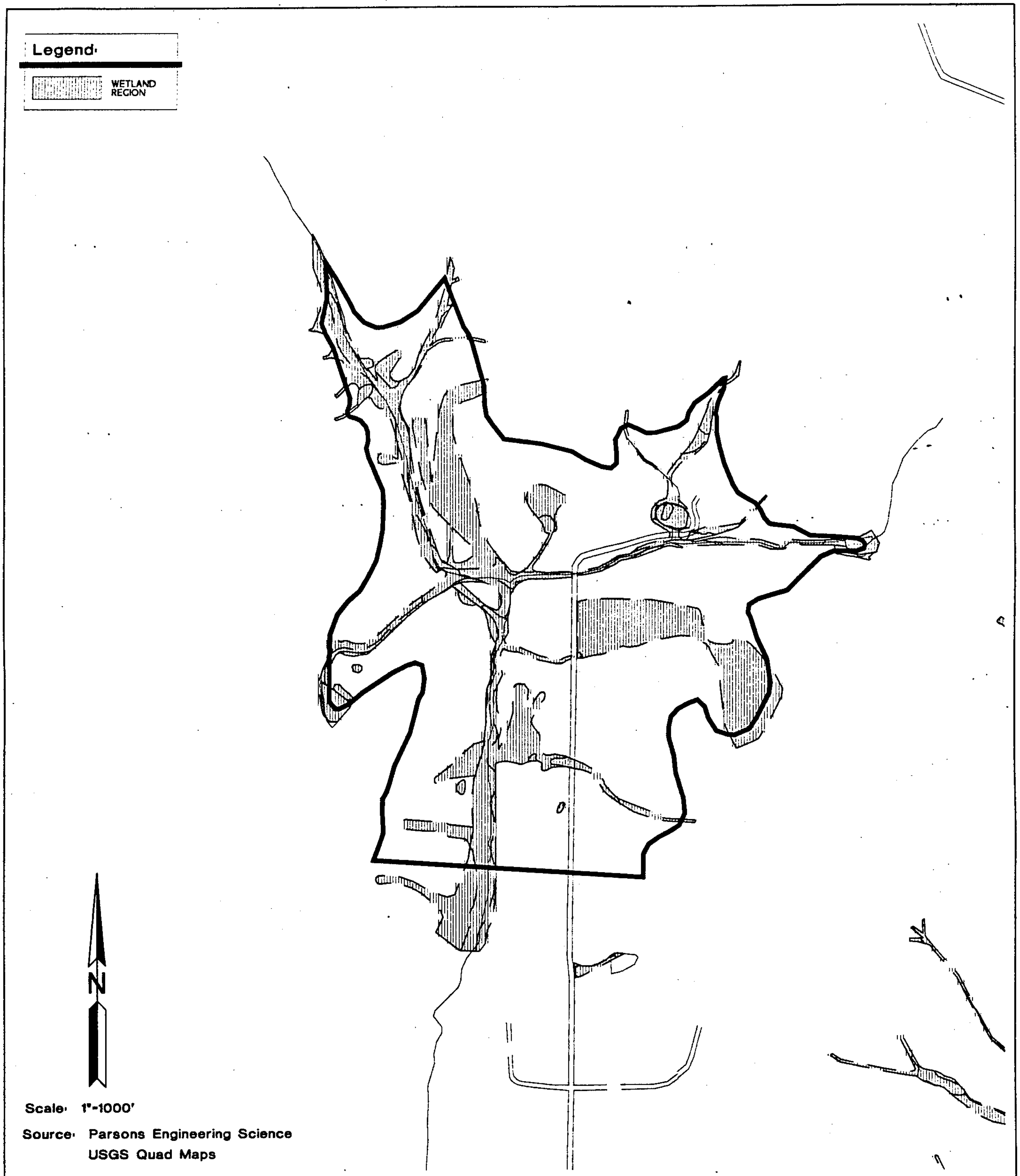
PARSONS

Santa Rosa

Subregional Long-Term
Wastewater Project

ESTIMATED
JURISDICTIONAL
WATERS
BLOOMFIELD RESERVOIR

Figure 4.10-7



HARLAND BARTHOLOMEW and ASSOCIATES, INC.

A UNIT OF PARSONS INFRASTRUCTURE and TECHNOLOGY GROUP INC.

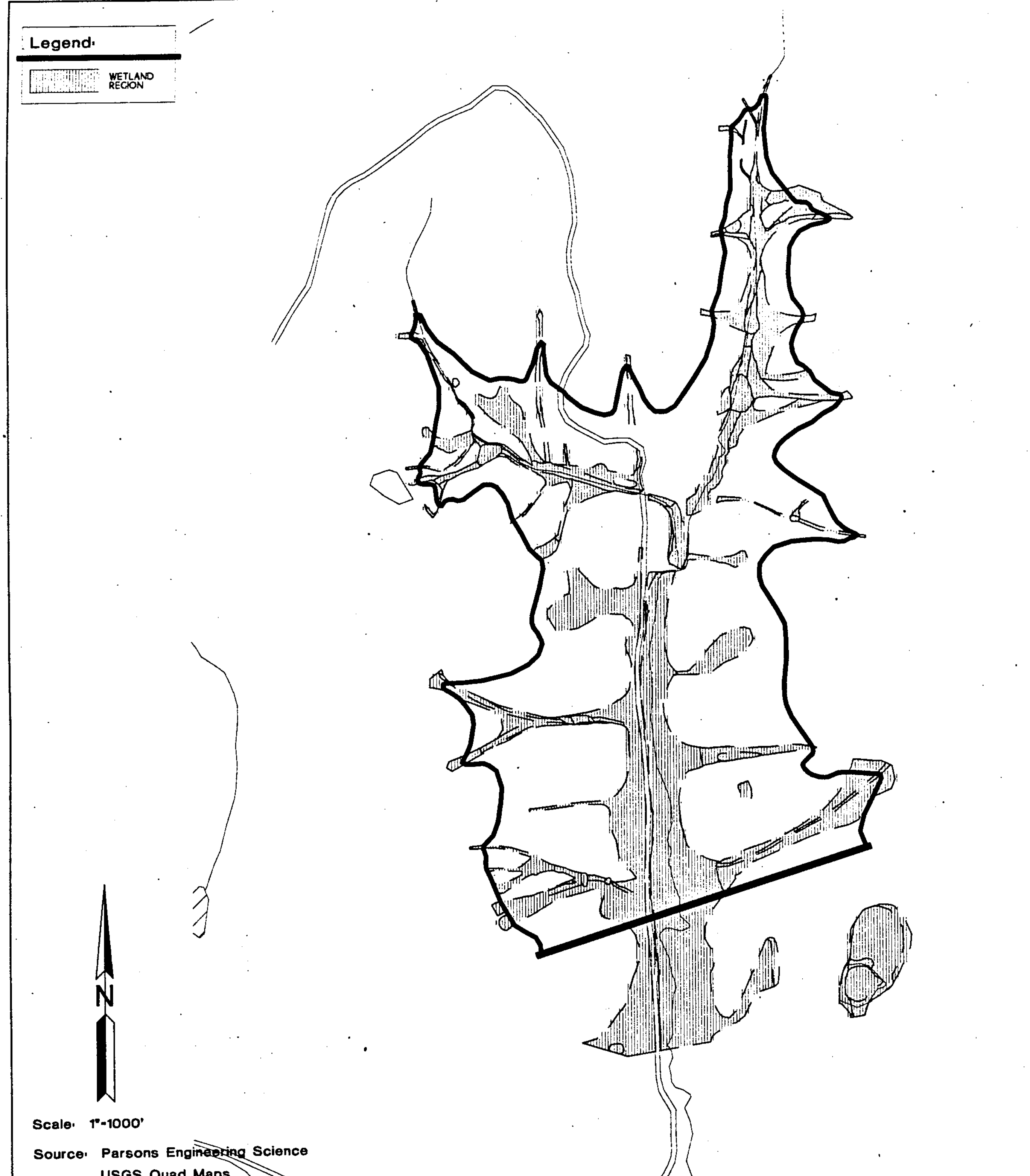
PARSONS

Santa Rosa

Subregional Long-Term Wastewater Project

ESTIMATED JURISDICTIONAL WATERS CARROLL ROAD RESERVOIR

Figure 4.10-8



HARLAND BARTHOLOMEW and ASSOCIATES, INC.

A UNIT OF PARSONS INFRASTRUCTURE and TECHNOLOGY GROUP INC.

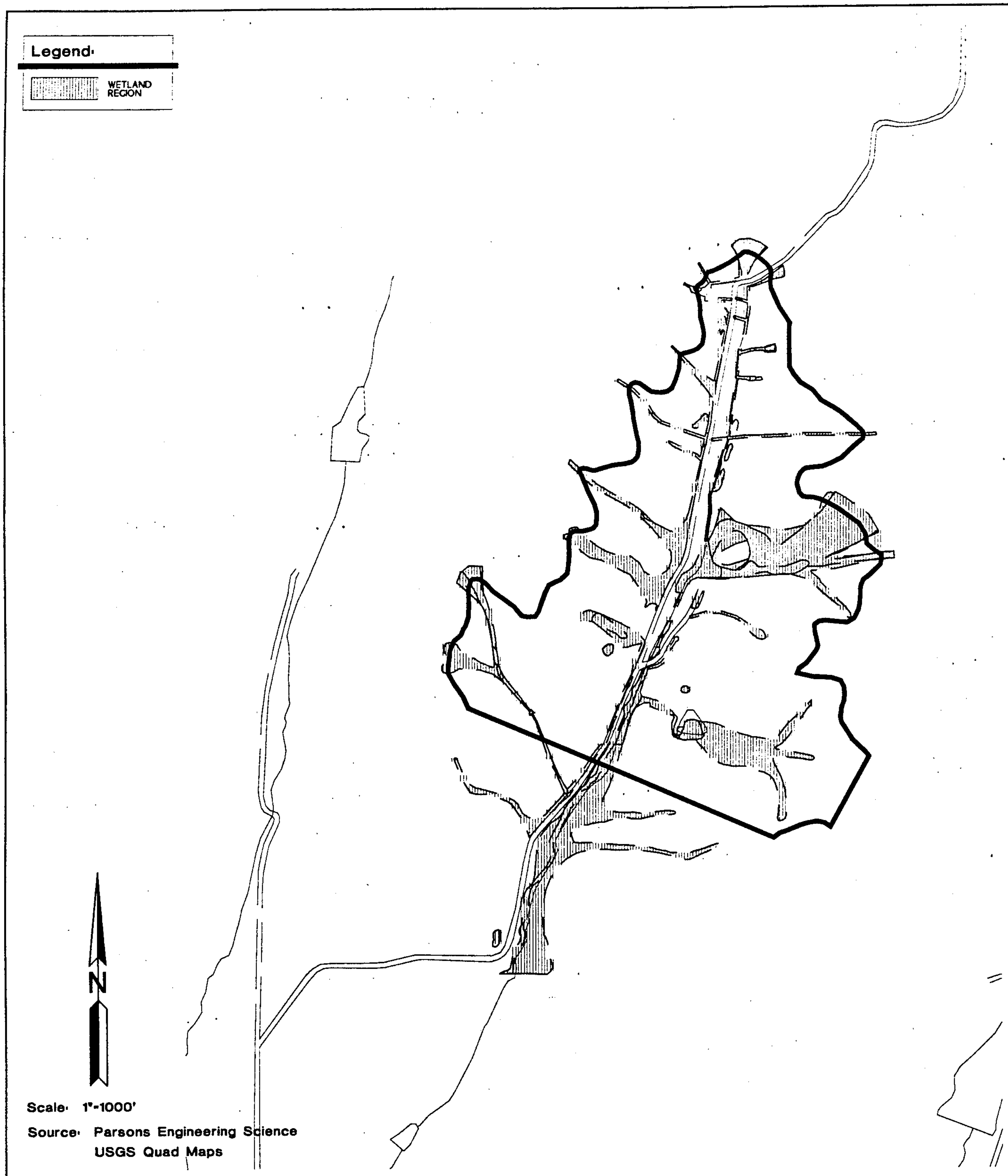
PARSONS

Santa Rosa

Subregional Long-Term Wastewater Project

ESTIMATED JURISDICTIONAL WATERS VALLEY FORD RESERVOIR

Figure 4.10-9



HARLAND BARTHOLOMEW and ASSOCIATES, INC.

A UNIT OF PARSONS INFRASTRUCTURE and TECHNOLOGY GROUP INC.

PARSONS

Santa Rosa

Subregional Long-Term Wastewater Project

ESTIMATED JURISDICTIONAL WATERS HUNTLEY RESERVOIR

Figure 4.10-10

Pump Station Component

Impact: **10.6.1. Will the Pump Station Component destroy wetlands or other waters of the U.S.?**

Analysis: *No Impact; All Alternatives.*

Measure 2.2.5, Avoid Sensitive Biological Resources, establishes (contained in Section 7.2, Measures Included in the Project) procedures for avoidance and minimization of construction impacts to jurisdictional waters including wetland, streams, creeks and channels. Wetlands determinations have identified wetlands in the vicinity of several pump station sites. Wetland delineations of proposed pump station locations will be conducted prior to final Project design. Project siting and design will reflect avoidance of identified jurisdictional wetlands and other waters of the U.S. with an associated exclusionary buffer. The designated construction zone for pump stations will be designed to allow a minimum 100-foot exclusionary buffer for all jurisdictional wetlands and other waters of the U.S. A mesh fence will be installed at the boundary of all exclusionary buffer zones. As a result, there will be no impact associated with permanent or temporary discharge or placement of fill in wetlands or other waters of the U.S.

Alternatives 1 and 5 do not have a new pump station component.

Mitigation: No mitigation is needed.

Agricultural Irrigation Component

Impact: **10.7.1. Will the agricultural irrigation component destroy wetlands or other waters of the U.S.?**

Analysis: *No Impact; All Alternatives.*

Results of assessments of wetlands and other jurisdictional waters within proposed agricultural irrigation areas indicate that all the agricultural irrigation areas contain jurisdictional wetlands (see Table 4.10-7). Impacts to these waters through operation and maintenance of an agricultural irrigation system will be avoided through implementation of Measure 2.2.2, Irrigation Site Resource Maps, and Measure 2.2.5, Avoid Sensitive Biological Resources (contained in Section 2.2, Measures Included in the Project). Measure 2.2.5 establishes buffers for all jurisdictional waters located on all parcels brought into agricultural production with Project reclaimed water (existing cropping patterns and practices are exempt). A

minimum 30-foot exclusionary buffer from irrigation application will be established around all jurisdictional waters, including isolated wetlands, and a minimum 50-foot exclusionary buffer from agricultural irrigation application will be established around the upland riparian corridor of all linear waterways, including streams, creeks, and rivers. Agricultural irrigation would not result in discharge or fill to wetlands, and therefore there is no impact. The Contingency Plan would allow winter irrigation of agricultural areas, which would be subject to the same limitations described above. Therefore, no impacts to jurisdictional wetland or waters of the U.S. would occur.

Pipe rupture or leakage will not result in greater than one acre of permanent wetland fill.

Alternatives 1, 4, and 5 do not have an agricultural irrigation component.

Mitigation: No further mitigation is needed.

Table 4.10-7

Wetlands - Acreage Observed at Each Irrigation Area
(acres)

Wetland Type	Adobe Road	Rohnert Park	North Petaluma	Lakeville	Misc.	Sebastopol	Stemple	Americano	Bay Flats
Annual Grassland Wetland	35	148	104	80	51	49	343	394	38
Unknown Vegetation Type	4	4	<1	7	<1	4	2	36	650
Brackish Water Marsh	0	0	0	0	0	0	0	74	0
Drainage	2	4	7	4	<1	0	7	6	2
Excavated Drainage	<1	0	<1	<1	0	0	<1	0	26
Freshwater Marsh	0	0	0	0	0	29	0	0	0
Freshwater Pond	1	6	0	21	5	20	56	16	<1
Freshwater Seep	0	<1	0	0	0	0	1	3	0
Mixed Riparian Woodland	18	19	1	4	3	66	2	<1	0
Native Grassland Wetlands	0	<1	0	0	0	1	0	<1	<1
Non-wooded Riparian	<1	4	1	16	1	<1	2	4	0
Seasonally Wet Vegetation	<1	45	256	16	2	96	270	253	58
Urban	1	1	3	2	<1	4	26	18	11
Vernal Pool	0	6	1	1	0	0	1	3	17
Willow Riparian	12	3	4	2	2	25	7	16	0

Table 4.10-7

Wetlands - Acreage Observed at Each Irrigation Area (acres)

Wetland Type	Adobe Road	Rohnert Park	North Petaluma	Lakeville	Misc.	Sebastopol	Stemple	Americano	Bay Flats
Cropland (Farmed Wetland)	45	410	7	<1	2	11	134	45	58
Total	128	649	383	161	66	305	854	868	861

Source: Harland Bartholomew & Associates, Inc., 1996

1 Acreage based upon tentative identification of these croplands as farmed wetlands, however, wetlands in cropland may qualify as prior converted cropland under NRCS rules and therefore would not fall under Section 404 jurisdiction.

Geysers Steamfield Component

Impact: **10.8.1. Will the geysers steamfield component destroy wetlands or other waters of the U.S.?**

Analysis: *No Impact; All Alternatives.*

The potential tank sites and associated construction zones are located in upland habitats on hilltops, thus there are no Projected discharge or fills to wetlands and other jurisdictional waters. The majority of in-field pipelines will be suspended or buried along existing pipeline corridors. Impacts to wetlands due to buried pipeline and access roads construction will be avoided through implementation of Measure 2.2.5, Avoid Sensitive Biological Resources as described in Section 2.2, Measures Included in the Project.

Alternatives 1, 2, 3, and 5 do not have a geysers steamfield component.

Mitigation: No further mitigation is needed.

Discharge Component

Table 4.10-8

Jurisdictional Wetlands Resources Component Impacts - Discharge

Evaluation Criterion	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
10.9.1. Will the discharge component destroy wetlands or other waters of the U.S.?	Greater than 0 acres of permanent discharge or placement of fill			
• Russian River discharge		0.9 acres	C, P	⊙
• Laguna Discharge		None	C, P	—

Source: Harland Bartholomew & Associates, Inc., 1996

Notes:

1. Type of Impact
   - C Construction
   - P Permanent
2. Level of Significance Codes
   - ⊙ Less than significant impact; no mitigation proposed
   - — Not applicable

Impact: **10.9.1. Will the discharge component destroy wetlands or other waters of the U.S.?**

Analysis: *Significant; Alternative 5A*

The assumed area of permanent disturbance for the outfall energy dissipater will be 100 feet by 100 feet. Temporary impacts will occur within 100 feet of the dissipater. Since the most conservative estimate of total wetland impact will be 0.9 acres, this impact is considered significant..

No Impact; Alternatives 1, 2, 3, 4, and 5B.

Laguna discharge will occur through existing outlets, so there will be no construction impacts within the Laguna. The discharge itself will increase the amount of water in the Laguna, but this increase will be negligible, except in very dry years. In those dry years, the effect of discharge will be to dampen the annual fluctuations: the hydrologic regime with discharge will be more closely approximate a slightly wetter year. This will not have a significant effect on wetlands.

Mitigation: *Alternative 5A.*

2.3.11. Sensitive Resource Conservation Program.

Alternatives 1, 2, 3, 4 and 5B. No mitigation is needed.

After Mitigation: *Less than Significant; Alternative 5A.*

Implementation of Measure 2.3.11, Sensitive Resource Conservation Plan will result in the replacement of wetlands function and acreage through creation, restoration and preservation of mitigation wetlands. There will be no net loss of wetland acreage or function.

CUMULATIVE IMPACTS

There is one impact -- either less than significant or significant -- identified in the Jurisdictional Wetlands section:

Impact: **10.1C. Will the Project plus cumulative projects destroy wetlands or other waters of the U.S.?**

Analysis: Alternatives 2, 3, 4, and 5.

The cumulative projects list identifies 504 projects which are undergoing some level of review by the U.S. Army Corps of Engineers for wetlands fill (see Appendix D-31) in the cumulative project area. The total acreage of fill involved in the cumulative projects is unknown. In keeping with the no net loss of wetlands policy set by the executive branch of the federal government, the Corps will likely require mitigation for wetlands losses associated with these projects.

Approximately 90% of the known wetlands of California have been lost since 1900. Of the remaining acreage, the California Coastal commission has rated 62% of coastal wetlands of California as severely damaged (Barbour et. al 1993). Sonoma and Marin counties have experienced similar losses. Due to the serious nature of wetlands losses and the governing factors of regulatory and governmental policy compliance (see Wetlands Section, Environmental Criteria with Point of Significance) any wetlands loss is considered a significant impact for the Project. There are significant wetlands losses identified with all of the alternatives of the Project (except Russian River discharge into the Laguna). Potential wetlands impacts associated with pipeline alignments have been avoided or minimized where feasible. The remaining impacts will be fully mitigated through the creation, restoration, and preservation of wetlands. Wetland impacts associated with pump stations and agricultural irrigation have been avoided through measures adopted as part of the Project. Wetland impacts associated with storage sites can neither be feasibly avoided or minimized. Similar to the pipeline impacts, wetlands loss due to the construction and operation of storage sites will be fully mitigated through creation, restoration, and preservation of wetlands. "Fully mitigated" means there will be no net loss of acreage or function of wetlands associated with the implementation of an alternative after mitigation.

Since there will be no net loss of wetland acreage or functions after mitigation of the Project, there are no wetlands impacts of the Project considered additive to the impacts of the cumulative projects. No changes in determination of significance or mitigation are warranted.

SUMMARY OF SIGNIFICANT IMPACTS AND MITIGATION MEASURES

Table 4.10-9

Summary of Significant Impacts and Mitigation Measures - Jurisdictional Wetlands Resources

Impact and Component	Level of Significance	Mitigation Measure
Pipelines Component		
10.4.1. The pipeline component may destroy wetlands or other waters of the U.S.	Alt 2 ⊙ Alt 3 ⊙ Alt 4 ⊙ Alt 5A ⊙	2.3.10 Limit Construction Disturbance.
Storage Reservoir Component		
10.5.1. The storage reservoir component may destroy wetlands or other waters of the U.S.	Alt 2 ⊙ Alt 3 ⊙	2.3.11 Sensitive Resource Conservation Program.
Discharge		
10.9.1. The discharge component may destroy wetlands or other waters of the U.S.	Alt 5A ⊙	2.3.11 Sensitive Resource Conservation Program.

Source: Harland Bartholomew & Associates, Inc., 1996

Notes:

⊙ Significant impact before mitigation; less than significant impact after mitigation

SUMMARY OF IMPACTS BY ALTERNATIVE

Table 4.10-10

Summary of Impacts by Alternative -Jurisdictional Wetlands Resources

Component	Alt 1	Alt 2A	Alt 2B	Alt 2C	Alt 2D	Alt 3A	Alt 3B	Alt 3C	Alt 3D	Alt 3E	Alt 4	Alt 5A	Alt 5B
No Action (No Project) Alternative	=	--	--	--	--	--	--	--	--	--	--	--	--
Headworks Expansion	--	=	=	=	=	=	=	=	=	=	=	=	=
Urban Irrigation	--	=	=	=	=	=	=	=	=	=	--	--	--
Pipelines	--	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	--
Storage Reservoirs	--	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	--	--	--
Pump Stations	--	=	=	=	=	=	=	=	=	=	=	=	--
Agricultural Irrigation	--	=	=	=	=	=	=	=	=	=	--	--	--
Geysers Steamfield	--	--	--	--	--	--	--	--	--	--	=	--	--
Discharge	--	=	=	=	=	=	=	=	=	=	=	⊙	=

Source: Harland Bartholomew & Associates, Inc., 1996

Notes:

Level of Significance

⊙ Significant impact before mitigation; less than significant impact after mitigation

○ Less than significant impact; no mitigation

= No impact

-- Not applicable

Table 4.10-11

Acreage of Wetland Impacts by Alternative and Type

Wetland Type	Alt 2A	Alt 2B	Alt 2C	ALT 2D	ALT 3A	ALT 3B	ALT 3C	ALT 3D	ALT 3E	ALT 4A	ALT 5A	ALT 5B
Annual Grassland Wetland	37	15	22	31	24	40	44	49	29	-	-	-
Undetermined vegetation type	< 1	4	< 1	5	2	2	4	>1	2	-	-	-
Drainage	6	<1	3	1	< 1	0	< 1	3	0	-	-	-
Excavated Drainage	6	0	4	0	0	0	0	0	0	-	-	-
Freshwater Marsh	0	0	0	0	< 1	0	0	0	0	-	-	-
Freshwater Pond	10	2	2	< 1	7	1	2	3	1	-	-	-
Freshwater Seep	< 1	1	< 1	1	16	0	< 1	2	2	-	-	-
Riparian Wetlands	18	27	18	34	12	14	16	9	6	3	1	0
Native Grassland Wetlands	4	<1	4	<1	4	0	<1	0	0	-	-	-
Seasonally Wet Vegetation	14	0	1	1	1	0	0	35	8	-	-	-
Cropland	152	0	32	0	0	0	0	0	0	-	-	-
Total	248	54	87	77	64	57	69	102	48	3	1	0

Source: Harland Bartholomew & Associates, Inc., 1996

PREPARERS, REFERENCES, AND CONSULTATION AND COORDINATION

Preparers

Joyce Hunting, Harland Bartholomew & Associates, Inc.
Mona Robison, Harland Bartholomew & Associates, Inc.

Reviewers

Adrian Juncosa, Harland Bartholomew & Associates, Inc.
Patricia I. Collins, Harland Bartholomew & Associates, Inc.
Robin P. Cort, Parsons Engineering Science, Inc.
Anders J. Hauge, Harland Bartholomew & Associates., Inc.
John Cummings, Ph.D., Peer Review Committee
David Ziegler, Peer Review Committee
Robert Gearhart, Ph.D., Peer Review Committee

References

HBA Team Documents

Harland Bartholomew & Associates, Inc. 1996a. *Biological Resources, Volume 1.* (Appendix K-1).

Harland Bartholomew & Associates, Inc. 1996b. *Biological Resource, Volume 4A.* (Appendix K-4).

Harland Bartholomew & Associates, Inc. 1996c *Biological Resource, Volume 4B.* (Appendix K-5).

Harland Bartholomew & Associates, Inc. 1996d *Biological Resource, Volume 4D.* (Appendix K-5).

Harland Bartholomew & Associates, Inc. 1996e *Biological Resource, Volume 4C.* (Appendix K-5).

Harland Bartholomew & Associates, Inc. 1996f. *Biological Resource, Volume 4E.* (Appendix K-5).

Parsons Engineering Science, Inc. 1996a. *Agricultural Irrigation Areas Wetlands Determination.* (Appendix M-1).

Parsons Engineering Science, Inc. 1996b. *Wetland Determination and Mitigation for Proposed Pipeline Alignments*. (Appendix M-2).

Parsons Engineering Science, Inc. 1996c. *Planning Level Wetland Determination Report for Proposed Reservoir Sites.* (Appendix M-3).

Dames and Moore. 1995. *Dam Break Inundation Analysis.* (Appendix J-1).

Merritt Smith Consulting. 1996a. *Environmental Conditions in West County Waterways.* June. (Appendix I-3).

Merritt Smith Consulting. 1996b. *Aquatic Habitat Survey Results.* (Appendix L-4).

Merritt Smith Consulting. 1996c. *Stream Crossings Assessment.* (Appendix I-15).

Merritt Smith Consulting. 1996d. *Aquatic Life Survey Results.* (Appendix L-5).

Merritt Smith Consulting. 1996e. *Aquatic Biological Resources Impacts Analysis Report.* (Appendix L-7).

Merritt Smith Consulting. 1995a. *Anadromous Fish Migration Study Program, 1991-1994.* April 11. (Appendix L-1).

Questa Engineering Corporation. 1996. *Irrigation Management Guidelines* for the West County and South County Alternatives. (Appendix D-19).

Other References

Adamus, P., L. Stockwell, E. Clairain, M. Morrow, L. Rozas, and R. Smith. 1991. *Wetland Evaluation Technique (WET)--Volume I*: Literature Review and Evaluation Rationale. U.S. Army Corps of Engineers, Washington, D.C.

Adamus, P., E. Clairain, R. Smith, and R. Young. 1987. *Wetland Evaluation Technique (WET)--Volume II*: Methodology. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Association of Bay Area Governments. 1991. *Status and Trends Report on Wetlands and Related Habitats in the San Francisco Estuary*. Oakland, CA.

Brinson, M. 1993. *A Hydrogeomorphic Classification for Wetlands*, Washington, D.C.

Brown & Caldwell and Jones & Stokes Associates. 1994. *Petaluma Wastewater Treatment and Storage Facilities Project - Draft Environmental Impact Report.*

California State Coastal Commission. 1987. *Draft Sonoma County Wetlands Enhancement Plan.*

CH2M Hill. 1995. *Final Santa Rosa Plain Vernal Pool Ecosystem Preservation Plan.*

Commins, M., J. Roth, M. Fawcett, and D. Smith. 1990. *Long-Term Detailed Wastewater Reclamation Studies - Santa Rosa Subregional Water Reclamation System - Technical Memorandum No. E8A.*

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. *Classification of Wetlands and Deepwater Habitats of the U.S.* U.S. Fish and Wildlife Service, Washington, D. C.

Environmental Laboratory. 1987. *Corps of Engineers Wetlands Delineation Manual.* Technical Report y-87-1. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Golden Bear Biostudies and North State Resources. 1990. *Long-Term Detailed Wastewater Reclamation Studies--Phase 2.* Santa Rosa Subregional Water Reclamation System Technical Memorandum No. W10.

Harvey, T. 1990. *Evolution of Wetlands in the Estero Americano - Long-Term Detailed Wastewater Reclamation Studies*, Santa Rosa Subregional Water Reclamation System Technical Memorandum No. W9.

Hickman, J. C. (ed.). 1993. *The Jepson Manual: Higher Plants of California.* University of California Press, Berkeley.

Holland, R. 1986. *Preliminary Descriptions of the Terrestrial Natural Communities of California.* California Department of Fish and Game, Sacramento, CA.

Madrone Associates. 1977. *The Natural Resources of Esteros Americano and de San Antonio.* California Department of Fish and Game, Sacramento, CA.

Mayer, K. E., and W. F. Laudenslayer, Jr. (editors). 1988. *A Guide to Wildlife Habitats of California*. California Department of Forestry and Fire Protection, Sacramento, CA.

Memorandum of Agreement. 1994. *California Inter-Agency Mapping Conventions for Waters of the U.S.* Agreement between the Department of Agriculture, EPA, Department of Interior, and the Department of the Army - December.

Memorandum of Understanding. 1995. *California Inter-Agency Mapping Conventions for Waters of the U.S.* Agreement between the Department of Agriculture, EPA, Department of Interior, and the Department of the Army.

National Audubon Society. 1992. *Saving Wetlands: A Citizen's Guide for Action in California*. National Audubon Western Regional Office, Sacramento.

Prunuske Chatham, Inc. 1994. *Stemple Creek/Estero de San Antonio Watershed Enhancement Plan*.

Sather, J. H. and R. D. Smith. 1984. *An Overview of Major Wetland Functions and Values*.

Shuford, W. D., and Timossi, I.C. 1989. *Plant Communities of Marin County*. California Native Plant Society, Sausalito, CA.

Smith, David W. Consulting & CH2M Hill. 1988. *Status Report - Reclamation Alternative Evaluation - Estero Americano Environmental Studies*.

Smith, David W. Consulting and CH2M Hill. 1990. *History, Land Uses and Natural Resources of the Laguna de Santa Rosa*.

U.S. Army Corps of Engineers. 1993. *Draft Wetlands Management Notebook*.

U.S. Department of Agriculture, Soil Conservation Service. 1972. *Soil Survey of Sonoma County*.

U.S. Department of Agriculture, Soil Conservation Service. 1994. *National Food Security Act Manual, Third Edition*.

U.S. Environmental Protection Agency. 1990. *Water Quality Standards for Wetlands - National Guidance.* Office of Water Regulations and Standards, Washington, DC.

Zedler, P.H. 1987. *The Ecology of Southern California Vernal Pools, a Community Profile.* Technical Report for the National Wetlands Research Center, U.S. Fish and Wildlife Service.

Consultation and Coordination

Persons Contacted

N/A	Marin County Agricultural Commission
N/A	California Department of Water Resources
N/A	Sonoma County Farmlands Group
Pat Balderama	Marin County Planning Department
David Bannister	Sierra Club (Marin Chapter)
Fred Bodie	California Department of Fish & Game, Region 3 (Yountville)
Marsha Brockbank	San Francisco Bay Estuary Project
Mary Butterwick	EPA, San Francisco
Jim Bybee	National Marine Fisheries Service
Cathy Cairtier	Biological Resources Division U.S. ACOE, Broward County, FL
Michael Carlan	San Francisco Bay Water Quality Control Board
Richard Charter	Sonoma County Land Trust
Buddy Clairaine	U.S. Army Corps of Engineers, Vicksburg, MS
Bill Cox	California Department of Fish & Game - Region 3 (Yountville)

Julie Crucevich	Biological Resources Division U.S. ACOE, Broward County, FL
Dennis Dorch	Cotati Planning Department
Rich Eastabrook	Bureau of Land Management
Gary Fellers	Point Reyes National Seashore
Steve Ford	California Water Commission (Central District) - Biologist
Joe Gaffney	Rohnert Park Community Development Department
Bob Gaiser	Sonoma County Planning Department
Ann Howald	California Department of Fish & Game, Region 3 (Yountville)
Ron Keith	Mosquito Abatement District (Marin & Sonoma County)
Jan Knight	U.S. Fish & Wildlife Service, Sacramento, California
Joe Le Claire	San Francisco Bay Conservation & Development Commission
Kathryn Lodato	California Native Plant Society
Laurel Marcus	California State Coastal Conservancy
Dave Mattens	National Marine Fisheries Service
Carolyn McLain	University of California Cooperative Extension - Sonoma County
Ed Morris	California Water Commission
Dave Plummer	State Lands Commission
Barbara Salzman	Marin Audubon Society
Ceil Scandone	Association of Bay Area Governments

Lisa Shanks	National Resource Conservation Service, Sonoma County
Steve Sharp	California Association of Local Agency Formation Commission
Ken Stelling	U.S. Department of the Interior, Division of Oil & Gas
Kristin Tarp	U.S. Fish & Wildlife Service, Sacramento
Ed Ueber	National Oceanic and Atmospheric Association, Gulf of the Farallones National Marine Sanctuary
Bill Van Beckum	California Coastal Commission
Larry Van Sant	U.S. Army Corps of Engineers, Sacramento
Tuck Vath	North Coast Regional Water Quality Control Board
Robert Verner	Marin Agricultural Land Trust
Allison Willy	U.S. Fish & Wildlife Service, Sacramento
Larry Wycoff	California Department of Fish & Game, Sacramento
Kurt Yeiter	Petaluma Planning Department
Rick York	California Energy Commission

Correspondence

Ruth Pratt, USFWS, Ecological Services, Sacramento field Office, Reference Number PPN 364, March 26, 1996.

Darren Fong, USFWS, May 2, 1995, May 3, 1995.

Wade Eakle, Department of the Army, San Francisco District, San Francisco Corp of Engineers, September 27, 1995.

Dale A. Pierce, Acting Field Supervisor, USFWS, Ecological Services, Sacramento Field Office. Reference number 1-1-94-TA-409, February 9, 1994.

Joel A. Medlin, Field Supervisor, USFWS, Ecological Services, Sacramento Field Office, Reference number PPN 264, June 22, 1995.

Susan Lawrence, Biologist, USFWS, Arlington, VA, November 30, 1995.

Eilene Stone, USFWS, OR, November 29, 1994, December 20, 1994.

Brian Tweit, USFWS, Sacramento, CA, November 16, 1994, November 18, 1994.

Kelly Geer, USFWS, Sacramento, CA, November 17, 1994.

Allison Willy, USFWS, Sacramento CA, November 16, 1994, September 14, 1995.

Meri Moore, USFWS, Sacramento, CA, January 22, or 23, 1996.

Donna Hummel, USFWS, Sacramento, CA, March 22, 1995.

Debbie Osborne, CDFG, November 17, 1994, November 18, 1994, December 20, 1994, December 30, 1994.

John Brode, Biologist, CDFG, November 17, 1994, November 18, 1994, December 20, 1994, December 30, 1994

Bill Cox, Biologist, CDFG Region III, November 16, 1994, November 17, 1994, June 12, 1995, June 14, 1995, June 16, 1994